**Fishery Data Series No. 97-11**

# Stock Assessment of the Return of Late-run Chinook Salmon to the Kenai River, 1996

**by**

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**May 1997**

**Alaska Department of Fish and Game** **Division of Sport Fish**

## Symbols and Abbreviations

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**Weights and measures (metric)**

| | |
|---|---|
| centimeter | cm |
| deciliter | dL |
| gram | g |
| hectare | ha |
| kilogram | kg |
| kilometer | km |
| liter | L |
| meter | m |
| metric ton | mt |
| milliliter | ml |
| millimeter | mm |

**Weights and measures (English)**

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

Spell out acre and ton.

**Time and temperature**

| | |
|---|---|
| day | d |
| degrees Celsius | °C |
| degrees Fahrenheit | °F |
| hour (spell out for 24-hour clock) | h |
| minute | min |
| second | s |

Spell out year, month, and week.

**Physics and chemistry**

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

**General**

| | |
|---|---|
| All commonly accepted abbreviations. | e.g., Mr., Mrs., a.m., p.m., etc. |
| All commonly accepted professional titles. | e.g., Dr., Ph.D., R.N., etc. |
| and | & |
| at | @ |
| Compass directions: | |
| east | E |
| north | N |
| south | S |
| west | W |
| Copyright | © |
| Corporate suffixes: | |
| Company | Co. |
| Corporation | Corp. |
| Incorporated | Inc. |
| Limited | Ltd. |
| et alii (and other people) | et al. |
| et cetera (and so forth) | etc. |
| exempli gratia (for example) | e.g., |
| id est (that is) | i.e., |
| latitude or longitude | lat. or long. |
| monetary symbols (U.S.) | $, ¢ |
| months (tables and figures): first three letters | Jan,...,Dec |
| number (before a number) | # (e.g., #10) |
| pounds (after a number) | # (e.g., 10#) |
| registered trademark | ® |
| trademark | ™ |
| United States (adjective) | U.S. |
| United States of America (noun) | USA |
| U.S. state and District of Columbia abbreviations | use two-letter abbreviations (e.g., AK, DC) |

**Mathematics, statistics, fisheries**

| | |
|---|---|
| alternate hypothesis | $H_A$ |
| base of natural logarithm | e |
| catch per unit effort | CPUE |
| coefficient of variation | CV |
| common test statistics | F, t, $\chi^2$, etc. |
| confidence interval | C.I. |
| correlation coefficient | R (multiple) |
| correlation coefficient | r (simple) |
| covariance | cov |
| degree (angular or temperature) | ° |
| degrees of freedom | df |
| divided by | ÷ or / (in equations) |
| equals | = |
| expected value | E |
| fork length | FL |
| greater than | > |
| greater than or equal to | ≥ |
| harvest per unit effort | HPUE |
| less than | < |
| less than or equal to | ≤ |
| logarithm (natural) | ln |
| logarithm (base 10) | log |
| logarithm (specify base) | $\log_2$, etc. |
| mideye-to-fork | MEF |
| minute (angular) | ' |
| multiplied by | x |
| not significant | NS |
| null hypothesis | $H_O$ |
| percent | % |
| probability | P |
| probability of a type I error (rejection of the null hypothesis when true) | α |
| probability of a type II error (acceptance of the null hypothesis when false) | β |
| second (angular) | " |
| standard deviation | SD |
| standard error | SE |
| standard length | SL |
| total length | TL |
| variance | Var |

*FISHERY DATA SERIES NO. 97-11*

# STOCK ASSESSMENT OF THE RETURN OF LATE-RUN CHINOOK SALMON TO THE KENAI RIVER, 1996

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# ABSTRACT

The estimated total return of late-run chinook salmon *Oncorhynchus tshawytscha* to the Kenai River in 1996 was 66,286 (SE = 1,059) fish. This estimate does not include fish harvested in the recreational marine fishery near Deep Creek, which will be estimated by a postal questionnaire with results available in 1997. Total harvest in marine commercial gillnet fisheries (drift and set), the inriver personal use dip net fishery, and Kenaitze Indian educational set gillnet fishery was 12,037 chinook salmon. The total inriver return of late-run chinook salmon was 54,249 (SE = 1,059) fish estimated through hydroacoustic techniques and a creel survey of harvest downstream of the sonar counter. In the downstream section (Cook Inlet to the Soldotna Bridge), angler effort and harvest estimated from a creel survey were 238,495 (SE = 7,285) angler-hours and 5,984 (SE = 404) chinook salmon, respectively.

Release mortality from the inriver fishery upstream of the sonar counter was an estimated 64 (SE = 50) chinook salmon. Spawning escapement, which was estimated by subtracting total fishing mortality from total inriver return, was 48,054 (SE = 1,126) chinook salmon and exceeded the optimum spawning escapement of 22,300 stipulated in the management plan. The predominant age class of the commercial harvest, inriver return, and recreational harvest was age-1.4 fish.

Migratory timing models were used to project spawning escapement during the 1996 fishery. No additional restrictions to the fishery were required to achieve escapement goals. A relatively strong return allowed for an additional 4 days of recreational fishing in August.

Production from the 1984-1988 broods ranged from 0.98 to 2.13 returning fish per spawner. Production from the 1989 brood has been 2.26 returning fish per spawner, with age 8 to return in 1997. Production from the 1990 brood has been 2.09 returning fish per spawner, with ages 7 and 8 to return in 1997 and 1998, respectively.

Based on a sibling model, the forecast for the 1997 late-run return to the Kenai River is 120,514 (SE = 32,788) chinook salmon.



Key words: Kenai River, chinook salmon, *Oncorhynchus tshawytscha*, late run, creel survey, effort, harvest, migratory timing, sibling ratios, brood tables, sonar, forecast.


# INTRODUCTION

The largest freshwater recreational fishery in Alaska occurs in the Kenai River with an average of nearly 350,000 angler-days of effort each year from 1983-1995 (Mills 1984-1994, Howe et al. 1995 and 1996). This represents approximately 15% of the state's recreational fishing effort. The majority of angler effort occurs between the Soldotna Bridge and Cook Inlet (Figure 1) and is directed primarily at returning chinook salmon *Oncorhynchus tshawytscha* during May, June, and July.

Two stocks of Kenai River chinook salmon are recognized: an early run which enters the river from mid-May through June, and a late run which enters the river from late June through early August (Burger et al. 1985; Bendock and Alexandersdottir 1992). Early-run fish are destined primarily for tributary spawning locations although some mainstem spawning also occurs (Burger et al. 1985). Late-run fish are destined almost exclusively for mainstem spawning locations and are the focus of this report.

Prior to 1970, the recreational fishery in the Kenai River comprised shorebased anglers targeting sockeye salmon *O. nerka* in July and coho salmon *O. kisutch* in August and early September. In 1973, anglers began experimenting with bouncing brightly colored terminal gear along the river bottom from a drifting boat. This technique had been used effectively by anglers fishing for chinook salmon on rivers in the Pacific Northwest. It proved to be a very effective method for catching chinook salmon on the Kenai River, and the fishery expanded rapidly (Figure 2).

As fisheries targeting both the early and late runs grew during the early 1980s, concerns

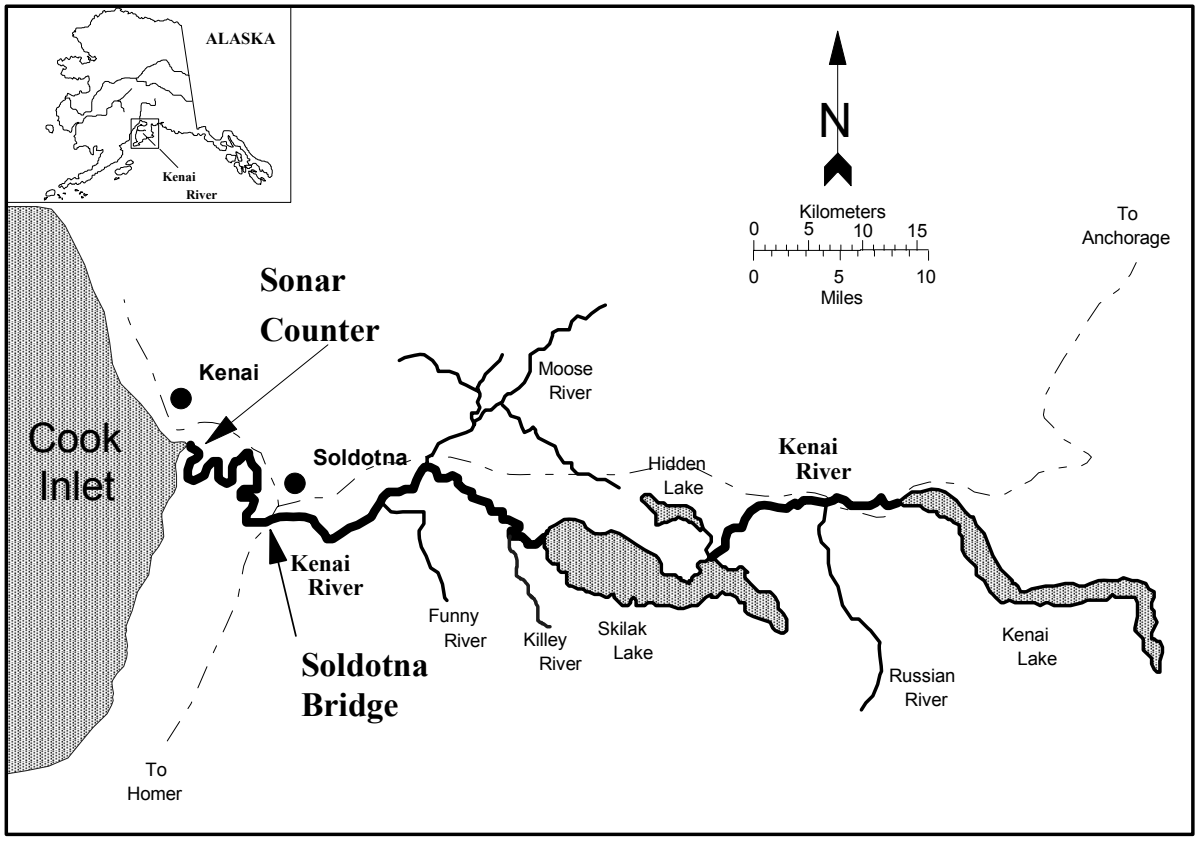


**Figure 1.-Map of the Kenai River drainage.**

about overexploitation were heightened. In 1988, the Board of Fisheries (BOF) adopted management plans for the early and late returns of chinook salmon to the Kenai River (McBride et al. 1989). These plans, which have been in effect since 1989, stipulate both escapement goals for which the fisheries will be managed by the Alaska Department of Fish and Game (ADF&G), and the manner in which these fisheries will be managed in the event of a conservation shortfall (Figure 3; Appendix A1).

Sport fishing regulations for chinook salmon in the Kenai River are detailed in the management plans, and are now among the most restrictive in Alaska. The recreational fishery for late-run chinook salmon on the Kenai River is 1 July through 31 July. Only the mainstem Kenai River between the outlet of Skilak Lake and Cook Inlet (Figure 1) is open to fishing for chinook salmon. The daily bag and possession limits are one chinook salmon per day greater than 41 cm (16 in) total length and a seasonal limit of two chinook salmon greater than 41 cm. Harvest of chinook salmon less than 41 cm is limited only by the daily bag limit of 10. An amendment to the late-run management plan, which went into effect during the 1991 season, provides for retention of large fish, 132 cm (52 in) or larger, if hook-and-release fishing is imposed (termed "trophy fishing").

Since 1983, fishing from boats downstream from the outlet of Skilak Lake has been prohibited on Mondays in July. Anyone retaining a chinook salmon that is 41 cm in

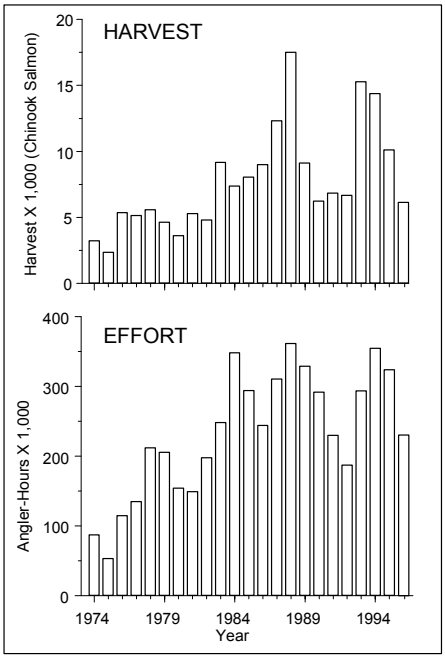


**Figure 2.-Historical harvest and effort in the recreational fishery for late-run chinook salmon, Kenai River, 1974-1996.**

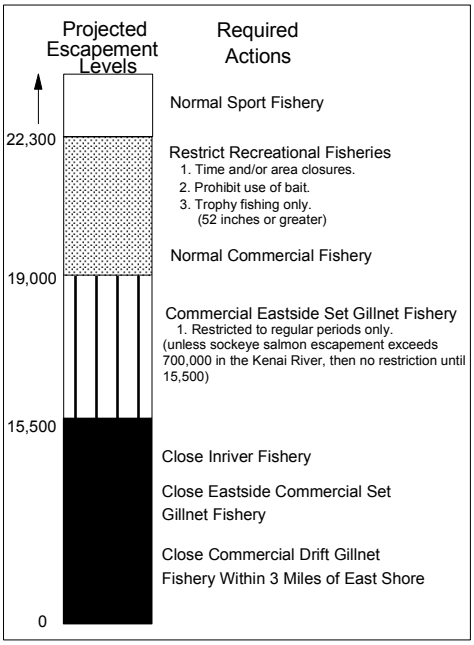


**Figure 3.-Escapement levels and required actions according to the Kenai River Late King Salmon Management Plan.**

length or greater is prohibited from fishing from a boat in the Kenai River for the remainder of that day. Anglers employing guides are restricted further: during July, fishing from a guided boat is allowed only between 0600 and 1800 hours, and on Tuesday through Saturday only.

Implementation of the management plan hinges upon the department's ability to project the strength of the current year's return early in the season. A comprehensive stock assessment program, which was initiated in the mid-1980s in response to the growing chinook salmon fisheries, and creel surveys, which have been conducted on the Kenai River since 1974, are the primary means of collecting the data necessary for implementing the plans. The objectives of these continuing studies are two-fold: to assess production by estimating harvest and abundance by age and inriver returns (Hammarstrom and Larson 1986)[1]; and to model run timing, including migratory timing estimates of effort, harvest, and abundance. Because of the diversity and complexity of these studies, results of each study are published in separate reports.

This report compiles statistics for the 1996 late run, including estimates of inriver return, total fishing mortality, and escapement. The estimates are compared to historic data and their application to the 1996 return is discussed. Finally, a forecast of the 1997 return is presented.

Previous studies of the chinook salmon fisheries in the Kenai River include the following: Hammarstrom (1975-1981, 1988-

[1] To clarify terms, inriver return refers to all fish that are counted by sonar in the Kenai River. Total return refers to all late-run Kenai River chinook salmon harvested in Upper Cook Inlet marine waters plus the inriver return. Escapement (fish that survive all fisheries and are potential spawners) is estimated by subtracting total mortalities from the recreational fishery (harvest plus hook-and-release mortalities) from the inriver return.

1991, 1992a and b, 1993a and b, 1994a and b, 1995, 1996); Hammarstrom and Larson (1982-1984, 1986); Hammarstrom et al. (1985); Conrad and Hammarstrom (1987); and King (1995, 1996). Details of the 1996 creel survey of the recreational fishery are reported by King (1997). In addition, angler effort and harvest by species for the recreational fishery were estimated by Mills (1979-1994) and Howe et al. (1995, 1996) via postseason postal questionnaire. Rationale for the escapement goals and migratory timing data to implement the management plans are contained in McBride et al. (1989). Bendock and Alexandersdottir (1992) estimated hooking mortality for chinook salmon in Kenai River recreational fisheries. Estimates of total return by age were summarized through 1990 by Sonnichsen and Alexandersdottir (1991) and 1991-1995 by Hammarstrom (1992b, 1993b, 1994b, 1995, 1996).

# SUMMARY OF HISTORICAL DATA

## HARVEST AND ESCAPEMENT

Late-run Kenai River chinook salmon are harvested at several locations during their spawning migration. Chinook salmon harvested in the marine waters of Cook Inlet after 1 July are assumed to be of Kenai River origin because chinook salmon of the Kasilof River, the only other population of late-run chinook salmon in Cook Inlet, are believed to be much less abundant than the Kenai River population (McBride et al. 1985). The first significant harvest of late-run chinook salmon occurs in the recreational marine fishery in the vicinity of Deep Creek. This harvest has been estimated by postal questionnaire, the results of which are unavailable until the following year (Mills 1979-1994; Howe et al. 1995, 1996). The estimates do not differentiate between early and late runs and thus the harvest of late-run fish was estimated based on the historical average proportion determined by creel surveys conducted onsite from 1973-1985 (Hammarstrom 1975-1981; Hammarstrom and Larson 1982-1984, 1986; Hammarstrom et al. 1985). In 1994 and 1995, Sport Fish Division once again surveyed this fishery with an onsite creel survey (McKinley 1995, 1996). In 1996, the fishery was sampled for age composition and coded-wire-tag recovery (McKinley *In prep*).

Additional harvest occurs in the commercial set gillnet fishery along the eastern shore of Cook Inlet and to a lesser degree in the commercial drift gillnet fishery. Total commercial harvest is determined from sales receipts (fish tickets) (ADF&G *Unpublished*). Both of these commercial fisheries target sockeye salmon and the chinook salmon harvest is bycatch. The commercial fisheries are managed according to the Upper Cook Inlet Salmon Management Plan.

Two single-net educational fisheries for members of the Kenaitze Indian tribe and the Village of Ninilchik have been authorized since 1989 and 1994, respectively, and total harvest is reported to the department per the terms of the permits.

Inriver returns have been estimated annually since 1984. Two methods have been employed: a mark-recapture program from 1984-1990 (Hammarstrom and Larson 1986; Conrad and Larson 1987; Conrad 1988; Carlon and Alexandersdottir 1989; Alexandersdottir and Marsh 1990); and a hydroacoustic (sonar) program from 1984-1995 (Eggers et al. 1995; Burwen and Bosch 1995a, 1995b, 1996). Since 1987, sonar has been used to estimate the inriver return. The mark-recapture program was last conducted in 1990. Since 1984, the inriver return has averaged 42,740 chinook salmon.

The inriver return is sampled to estimate abundance by age. Prior to 1991, scale samples were collected from chinook salmon captured with large-mesh gillnets during the

mark-recapture studies. Although the marking program was discontinued in 1991, age, sex, and length samples are still collected using gillnets (Hammarstrom and Larson 1986).

The commercial set gillnet harvest in Cook Inlet is sampled for age, sex, and size composition by the Commercial Fisheries Management and Development Division (CFMD) of ADF&G (Waltemyer and Tobias 1997). These data provide estimates of the numbers of chinook salmon by age, sex, and size in the commercial set gillnet, drift gillnet, and subsistence gillnet harvests. Age, sex, and size composition of the drift, subsistence, and personal use gillnet harvests are assumed to be the same as the commercial set gillnet harvest because the gear is similar and harvest in the subsistence and personal use fisheries is relatively minor.

The age, sex, and size composition of the sport harvest in the Kenai River is estimated from samples collected during angler interviews conducted in the creel survey (King 1997).

Mortality due to hook-and-release fishing on late-run fish was estimated to be 13.2% for small males (< 750 mm); 5.0% for large males (> 750 mm); and 5.0% for females (Bendock and Alexandersdottir 1992). However, it is not possible to measure the size or sex composition of the release component. Therefore, a grand average of the estimated mortality rates on late-run fish (8.3%) was used to estimate hook-and-release mortality for this stock. Because of the higher mortality for small males and the tendency of anglers to release smaller fish, this approach tends to underestimate mortality. Age, sex, and size composition of the fish that were released and died was assumed equal to that of the inriver return. This assumption also introduces an unknown bias to estimates.

## BROOD AND SIBLING RELATIONSHIPS

Chinook salmon in the Kenai River are managed to achieve optimum sustained production. In 1988, spawning requirements were computed to sustain levels of production realized during the years 1984 to 1988. These escapement goals were based on limited information from the Kenai River and the experiences of other researchers working with chinook salmon on the west coast of North America (McBride et al. 1989). Total return data are being compiled to assess production and refine these escapement goals. A good stock-recruit analysis requires data that span decades, since one year's return must be compared to returns from parent generations many years earlier.

A predictable relationship between consecutive-year returns of the same brood (i.e. sibling relationships) was established for the late run (Sonnichsen and Alexandersdottir 1991). As a result, mean sibling ratios (the ratio of one age to one or more younger ages for a brood) for years with complete return data were used to predict returns for 1990-1996. By using mean sibling ratios of those years for which complete return data are available, models were developed to predict the returns for 1990-1996 (Sonnichsen and Alexandersdottir 1991; Hammarstrom 1992a, 1993a, 1994a, 1995; 1996, Appendix B1).

## MIGRATORY TIMING

The following databases were used to estimate the annual migratory timing of chinook salmon returning to the Kenai River during the late run: (1) inriver return, measured by daily gillnet CPUE for 1984 to 1986 and by daily sonar counts for 1987 to 1995; and (2) inriver recreational fishery statistics including angler effort, harvest, and catch for 1984-1995.

Historic cumulative daily proportions of each of these statistics were used to generate migratory timing models of each statistic that

were applied to the current year's data to predict season-end values (McBride et al. 1989; Appendix B2). Cumulative daily proportions of the inriver return for the years 1985-1995 were averaged to formulate the model (referred to as mean timing model) that projected total inriver return for 1996 (Appendix C1). Although other models have been evaluated (Hammarstrom 1994b), the mean timing model has been the most consistent and was utilized in 1996.

Cumulative daily proportions of recreational effort, harvest, and catch for the years 1984-1995 were used to generate the model that projected harvest and catch for 1996 (Appendices C2-C7).

Projected end-of-season escapement was the difference between the projected end-of-season inriver return and the projected end-of-season mortality (harvest plus hook-and-release mortality) which was updated daily throughout the season.

# ASSESSMENT OF THE 1996 LATE RETURN OF CHINOOK SALMON TO THE KENAI RIVER

## EFFORT AND HARVEST OF LATE-RUN CHINOOK SALMON

Estimates of harvest from the 1996 recreational marine fishery near Deep Creek are unavailable until the results of the 1996 postal questionnaire are reported in 1997.

The commercial harvest in the set gillnet fishery along the eastern shore of Cook Inlet was 11,333 chinook salmon, approximately the 1984-1995 mean harvest of chinook salmon in that fishery. Harvest of chinook salmon in the drift gillnet fishery was 365 fish, well below the historical mean. A reported 45 chinook salmon were retained for personal use from the combined commercial set and drift gillnet harvest (Table 1).

Age composition of the commercial set gillnet harvest was based on a sample of 2,184 chinook salmon with readable scales. Because there was a significant ($\chi^2$ = 380.6, df = 9, P < 0.01) difference in the age composition of the four major age groups over time, the age data were poststratified into four time intervals to estimate harvest by age. The commercial set gillnet harvest comprised mostly chinook salmon aged 1.4 (43%), 1.3 (35%), and 1.2 (16%) (Table 2).

In 1996, no personal use (termed subsistence in 1994) set gillnet fishery was authorized in Cook Inlet. However, a personal use dip net fishery was allowed in the lower 9.3 km (5.0 miles) of the Kenai River. Participants were required to be Alaska residents and obtain a permit from the department. Harvest was recorded on the permit which had to be returned to the department by the end of the season. These fisheries were administered by the Sport Fish Division. Only chinook salmon harvested from 1 July and later were considered of late-run Kenai River origin. Total subsistence harvest of late-run chinook salmon was 294 fish: 274 in the dip net fishery, 1 in the Kenaitze educational fishery, and 19 in the Ninilchik educational fishery (Table 1).

The 1996 inriver recreational fishery for late-run chinook salmon started 1 July. To more accurately estimate the inriver return and escapement, the creel survey of the recreational fishery in the Kenai River was stratified in 1996 to estimate harvest upstream and downstream of the sonar counter (King 1997). Creel data were also combined solely

## Table 1.-Summary of late-run Kenai River chinook salmon population data, 1984-1996.

| Year | Deep Creek Marine Harvest | Set Net Harvest | Drift Gillnet Harvest | Personal Use | Subsistence[a] | Kenai River Inriver Return | Kenai River Total Return | Kenai River Sport Harvest | Kenai River Release Mortality | Kenai River Escapement |
|---|---|---|---|---|---|---|---|---|---|---|
| 1984 | 835 | 6,165 | 1,377 | | | 39,172 | 47,549 | 7,376 | Unknown | 31,796 |
| 1985 | 1,731 | 17,723 | 2,046 | | | 29,763 | 51,263 | 8,055 | Unknown | 21,708 |
| 1986 | 630 | 19,810 | 1,834 | | | 57,563 | 79,837 | 9,004 | 522 | 48,037 |
| 1987 | 1,097 | 20,588 | 4,551 | | | 48,123 | 74,359 | 12,237 | 368 | 35,518 |
| 1988 | 1,262 | 12,870 | 2,216 | | | 52,008 | 68,356 | 17,512 | 472 | 34,024 |
| 1989 | 1,294 | 10,919 | 0 [b] | 4 | 22 | 29,035 | 41,274 | 9,127 | 327 | 19,581 |
| 1990 | 1,318 | 4,139 | 621 | 91 | 13 | 33,474 | 39,656 | 6,247 | 141 | 27,086 |
| 1991 | 1,325 | 4,891 | 241 | 130 | 288 | 34,614 | 41,489 | 6,849 | 103 | 27,662 |
| 1992 | 2,346 | 10,718 | 543 | 50 | 402 [c] | 30,314 | 44,373 | 6,680 | 308 | 23,326 |
| 1993 | 3,344 | 14,002 | 751 | 129 | 27 [d] | 49,674 | 67,927 | 15,279 | 363 | 34,032 |
| 1994 | 2,301 | 15,885 | 460 | 13 | 392 [e] | 53,281 | 72,332 | 14,388 | 344 | 38,549 |
| 1995 | 2,539 | 12,032 | 523 | 36 | 646 [f] | 44,336 | 60,112 | 10,125 | 312 | 33,899 |
| 1996[g] | Unknown | 11,333 | 365 | 45 | 294 [h] | 54,249 [i] | 66,286 | 5,816 [j] | 64 | 48,369 |

[a] Includes harvest in Kenaitze educational gillnet fishery.

[b] Drift gillnet fishery closed due to *Exxon Valdez* oil spill.

[c] Includes 10 fish harvested in the Kenaitze educational fishery, 260 fish harvested in the subsistence set net fishery and 132 fish harvested in the subsistence dip net fishery.

[d] Only Kenaitze educational fishery open to subsistence fishing.

[e] Includes 1 fish harvested in the Kenaitze educational fishery, 274 fish harvested in the subsistence set net fishery and 117 fish harvested in the subsistence dip net fishery.

[f] Includes 2 fish harvested in the Kenaitze educational fishery, 580 fish harvested in the subsistence set net fishery, 74 fish harvested in the subsistence dip net fishery, and 12 fish harvested in the Ninilchik educational fishery.

[g] Preliminary data.

[h] Includes 1 fish harvested in the Kenaitze educational fishery, 274 fish harvested in the personal use dip net fishery and 19 fish harvested in the Ninilchik educational fishery.

[i] Includes 4,179 fish identified as downstream targets, 304 fish harvested and 11 mortalities from hook-and-release fishing downstream of the sonar counter.

[j] Fishing mortality upstream of the sonar counter.

**Table 2.-Estimates by age class of the number of Kenai River late-run chinook salmon harvested in the Upper Subdistrict commercial set and drift gillnet fisheries, personal use fisheries, and educational fisheries, Upper Cook Inlet, 1996.**

| | Age Class | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.1 | 1.2 | 1.3 | 2.2 | 1.4 | 2.3 | 1.5 | 2.4 | 2.5 | Total |
| 1 July - 8 July | | | | | | | | | | |
| **Males** | | | | | | | | | | |
| Sample Size | 63 | 199 | 124 | 1 | 61 | 1 | 8 | 0 | 0 | 457 |
| Percent | 11.4 | 35.9 | 22.3 | 0.2 | 11.0 | 0.2 | 1.4 | 0.0 | 0.0 | 82.3 |
| SE Percent | 1.3 | 2.0 | 1.8 | 0.2 | 1.3 | 0.2 | 0.5 | 0.0 | 0.0 | 1.6 |
| Harvest | 208 | 658 | 410 | 3 | 203 | 3 | 26 | 0 | 0 | 1,510 |
| SE Harvest | 25 | 37 | 32 | 3 | 24 | 3 | 9 | 0 | 0 | 30 |
| **Females** | | | | | | | | | | |
| Sample Size | 1 | 5 | 37 | 0 | 52 | 1 | 1 | 1 | 0 | 98 |
| Percent | 0.2 | 0.9 | 6.7 | 0.0 | 9.4 | 0.2 | 0.2 | 0.2 | 0.0 | 17.7 |
| SE Percent | 0.2 | 0.4 | 1.1 | 0.0 | 1.2 | 0.2 | 0.2 | 0.2 | 0.0 | 1.6 |
| Harvest | 3 | 17 | 122 | 0 | 172 | 3 | 3 | 2 | 0 | 324 |
| SE Harvest | 3 | 7 | 19 | 0 | 23 | 3 | 3 | 3 | 0 | 30 |
| **Combined** | | | | | | | | | | |
| Sample Size | 64 | 204 | 161 | 1 | 113 | 2 | 9 | 1 | 0 | 555 |
| Percent | 11.5 | 36.8 | 29.0 | 0.2 | 20.4 | 0.4 | 1.6 | 0.2 | 0.0 | 100.0 |
| SE Percent | 1.4 | 2.0 | 1.9 | 0.2 | 1.7 | 0.3 | 0.5 | 0.2 | 0.0 | |
| Harvest | 211 | 674 | 532 | 3 | 373 | 7 | 30 | 3 | 0 | 1,834 |
| SE Harvest | 25 | 38 | 35 | 3 | 31 | 5 | 10 | 3 | 0 | |
| 9 July - 16 July | | | | | | | | | | |
| **Males** | | | | | | | | | | |
| Sample Size | 29 | 131 | 166 | 3 | 95 | 3 | 8 | 2 | 0 | 437 |
| Percent | 4.6 | 20.6 | 26.1 | 0.5 | 14.9 | 0.5 | 1.3 | 0.3 | 0.0 | 68.6 |
| SE Percent | 0.8 | 1.6 | 1.7 | 0.3 | 1.4 | 0.3 | 0.4 | 0.2 | 0.0 | 1.8 |
| Harvest | 149 | 672 | 852 | 15 | 488 | 15 | 41 | 10 | 0 | 2,243 |
| SE Harvest | 27 | 52 | 57 | 9 | 46 | 9 | 14 | 7 | 0 | 60 |
| **Females** | | | | | | | | | | |
| Sample Size | 0 | 0 | 71 | 0 | 127 | 1 | 1 | 0 | 0 | 200 |
| Percent | 0.0 | 0.0 | 11.1 | 0.0 | 19.9 | 0.2 | 0.2 | 0.0 | 0.0 | 31.4 |
| SE Percent | 0.0 | 0.0 | 1.2 | 0.0 | 1.6 | 0.2 | 0.2 | 0.0 | 0.0 | 1.8 |
| Harvest | 0 | 0 | 364 | 0 | 652 | 5 | 5 | 0 | 0 | 1,026 |
| SE Harvest | 0 | 0 | 41 | 0 | 52 | 5 | 5 | 0 | 0 | 60 |
| **Combined** | | | | | | | | | | |
| Sample Size | 29 | 131 | 237 | 3 | 222 | 4 | 9 | 2 | 0 | 637 |
| Percent | 4.6 | 20.6 | 37.2 | 0.5 | 34.9 | 0.6 | 1.4 | 0.3 | 0.0 | 100.0 |
| SE Percent | 0.8 | 1.6 | 1.9 | 0.3 | 1.9 | 0.3 | 0.5 | 0.2 | 0.0 | |
| Harvest | 149 | 672 | 1,216 | 15 | 1,139 | 21 | 46 | 10 | 0 | 3,269 |
| SE Harvest | 27 | 52 | 63 | 9 | 62 | 10 | 15 | 7 | 0 | |

-continued-

**Table 2.-Page 2 of 3.**

| | Age Class | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.1 | 1.2 | 1.3 | 2.2 | 1.4 | 2.3 | 1.5 | 2.4 | 2.5 | Total |
| 17 July - 25 July | | | | | | | | | | |
| **Males** | | | | | | | | | | |
| Sample Size | 1 | 59 | 112 | 0 | 114 | 3 | 4 | 3 | 1 | 297 |
| Percent | 0.2 | 11.1 | 21.0 | 0.0 | 21.4 | 0.6 | 0.8 | 0.6 | 0.2 | 55.7 |
| SE Percent | 0.2 | 1.4 | 1.8 | 0.0 | 1.8 | 0.3 | 0.4 | 0.3 | 0.2 | 2.2 |
| Harvest | 7 | 417 | 791 | 0 | 805 | 21 | 28 | 21 | 7 | 2,099 |
| SE Harvest | 7 | 51 | 67 | 0 | 67 | 12 | 14 | 12 | 7 | 81 |
| **Females** | | | | | | | | | | |
| Sample Size | 0 | 0 | 84 | 0 | 141 | 4 | 6 | 1 | 0 | 236 |
| Percent | 0.0 | 0.0 | 15.8 | 0.0 | 26.5 | 0.8 | 1.1 | 0.2 | 0.0 | 44.3 |
| SE Percent | 0.0 | 0.0 | 1.6 | 0.0 | 1.9 | 0.4 | 0.5 | 0.2 | 0.0 | 2.2 |
| Harvest | 0 | 0 | 594 | 0 | 996 | 28 | 42 | 7 | 0 | 1,667 |
| SE Harvest | 0 | 0 | 59 | 0 | 72 | 14 | 17 | 7 | 0 | 81 |
| **Combined** | | | | | | | | | | |
| Sample Size | 1 | 59 | 196 | 0 | 255 | 7 | 10 | 4 | 1 | 533 |
| Percent | 0.2 | 11.1 | 36.8 | 0.0 | 47.8 | 1.3 | 1.9 | 0.8 | 0.2 | 100.0 |
| SE Percent | 0.2 | 1.4 | 2.1 | 0.0 | 2.2 | 0.5 | 0.6 | 0.4 | 0.2 | |
| Harvest | 7 | 417 | 1,385 | 0 | 1,802 | 49 | 71 | 28 | 7 | 3,766 |
| SE Harvest | 7 | 51 | 79 | 0 | 82 | 19 | 22 | 14 | 7 | |
| 26 July -14 August | | | | | | | | | | |
| **Males** | | | | | | | | | | |
| Sample Size | 1 | 17 | 85 | 0 | 127 | 12 | 1 | 0 | 0 | 243 |
| Percent | 0.2 | 3.7 | 18.5 | 0.0 | 27.7 | 2.6 | 0.2 | 0.0 | 0.0 | 52.9 |
| SE Percent | 0.2 | 0.9 | 1.8 | 0.0 | 2.1 | 0.7 | 0.2 | 0.0 | 0.0 | 2.3 |
| Harvest | 7 | 117 | 587 | 0 | 877 | 83 | 7 | 0 | 0 | 1,677 |
| SE Harvest | 7 | 28 | 58 | 0 | 66 | 24 | 7 | 0 | 0 | 74 |
| **Females** | | | | | | | | | | |
| Sample Size | 0 | 0 | 74 | 0 | 134 | 4 | 3 | 1 | 0 | 216 |
| Percent | 0.0 | 0.0 | 16.1 | 0.0 | 29.2 | 0.9 | 0.7 | 0.2 | 0.0 | 47.1 |
| SE Percent | 0.0 | 0.0 | 1.7 | 0.0 | 2.1 | 0.4 | 0.4 | 0.2 | 0.0 | 2.3 |
| Harvest | 0 | 0 | 511 | 0 | 925 | 28 | 21 | 7 | 0 | 1,491 |
| SE Harvest | 0 | 0 | 54 | 0 | 67 | 14 | 12 | 7 | 0 | 74 |
| **Combined** | | | | | | | | | | |
| Sample Size | 1 | 17 | 159 | 0 | 261 | 16 | 4 | 1 | 0 | 459 |
| Percent | 0.2 | 3.7 | 34.6 | 0.0 | 56.9 | 3.5 | 0.9 | 0.2 | 0.0 | 100.0 |
| SE Percent | 0.2 | 0.9 | 2.2 | 0.0 | 2.3 | 0.9 | 0.4 | 0.2 | 0.0 | |
| Harvest | 7 | 117 | 1,097 | 0 | 1,801 | 110 | 28 | 7 | 0 | 3,168 |
| SE Harvest | 7 | 28 | 70 | 0 | 73 | 27 | 14 | 7 | 0 | |

-continued-

**Table 2.-Page 3 of 3.**

| | Age Class | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.1 | 1.2 | 1.3 | 2.2 | 1.4 | 2.3 | 1.5 | 2.4 | 2.5 | Total |
| Total | | | | | | | | | | |
| **Males** | | | | | | | | | | |
| Percent | 3.1 | 15.5 | 21.9 | 0.2 | 19.7 | 1.0 | 0.9 | 0.3 | 0.1 | 62.5 |
| SE Percent | 0.3 | 0.7 | 0.9 | 0.1 | 0.9 | 0.2 | 0.2 | 0.1 | 0.1 | 1.1 |
| Harvest | 371 | 1,864 | 2,640 | 19 | 2,372 | 123 | 103 | 31 | 7 | 7,528 |
| SE Harvest | 38 | 87 | 110 | 9 | 108 | 28 | 23 | 14 | 7 | 129 |
| **Females** | | | | | | | | | | |
| Percent | 0.0 | 0.1 | 13.2 | 0.0 | 22.8 | 0.5 | 0.6 | 0.1 | 0.0 | 37.5 |
| SE Percent | 0.0 | 0.1 | 0.8 | 0.0 | 0.9 | 0.2 | 0.2 | 0.1 | 0.0 | 1.1 |
| Harvest | 3 | 17 | 1,591 | 0 | 2,745 | 64 | 72 | 16 | 0 | 4,509 |
| SE Harvest | 3 | 7 | 92 | 0 | 114 | 21 | 22 | 10 | 0 | 129 |
| **Combined** | | | | | | | | | | |
| Percent | 3.1 | 15.6 | 35.1 | 0.2 | 42.5 | 1.6 | 1.4 | 0.4 | 0.1 | 100.0 |
| SE Percent | 0.3 | 0.7 | 1.1 | 0.1 | 1.1 | 0.3 | 0.3 | 0.1 | 0.1 | |
| Harvest | 374 | 1,881 | 4,231 | 19 | 5,116 | 187 | 174 | 49 | 7 | 12,037 |
| SE Harvest | 38 | 87 | 128 | 9 | 130 | 35 | 32 | 18 | 7 | |

to provide estimates that can be compared with those of previous years. Angler effort was an estimated 238,495 (SE = 7,285) angler-hours (King 1997). The estimated harvest of 5,984 (SE = 404) chinook salmon was only 78% of the 1974-1995 average (Table 3). Catch was an estimated 6,938 (SE = 428) chinook salmon. Anglers employing professional guides accounted for 65% of the harvest and 48% of the effort.

Based on a sample 234 fish with readable scales, there was a significant ($\chi^2 = 24.0$, df = 3, $P < 0.01$) difference in the age composition of the recreational harvest between two temporal strata, even of the two age groups that composed over 90% of the sport harvest ($\chi^2 = 6.7$, df = 1, $P = 0.01$). Because chinook salmon were sampled almost exactly in proportion to the harvest of the two temporal strata, combining the age data across the two strata did not produce biased estimates of harvest by age. Therefore, all samples were combined to estimate harvest by age (Table 4). The harvest was predominantly fish aged 1.4 (55%) with the proportion of fish aged 1.3 (37%) the second greatest observed since 1986 (Table 5).

In 1996, an estimated 13% of the catch was released (Table 6). Since 1986, the first year that estimates of total catch in the recreational fishery were available, an average of 27% of the catch was released. In 1996, release mortality upstream of the sonar counter was an estimated 64 (SE = 50) fish. The age and sex composition of the hook-and-release mortality was assumed equal to that of the inriver return (Table 7).

## INRIVER RETURN

The sonar was in operation from 16 May through 31 July (Burwen and Bosch *In prep*). Inriver return estimated past the sonar counter from 1 July through 31 July was 53,934

**Table 3.-Summary of historical harvest, angler effort, and harvest rate in the recreational fishery for late-run chinook salmon, Kenai River, 1974-1996.**

| | Harvest | | | Effort in Angler Hours | | | Harvest per Hour | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Unguided | Guided | Total | Unguided | Guided | Total | Unguided | Guided | Total |
| 1974 | | | 3,225 | | | 87,162 | | | 0.037 |
| 1975 | | | 2,355 | | | 53,523 | | | 0.044 |
| 1976 | | | 5,353 | | | 114,795 | | | 0.047 |
| 1977 | | | 5,148 | | | 135,082 | | | 0.038 |
| 1978 | | | 5,578 | | | 212,217 | | | 0.026 |
| 1979 | | | 4,634 | | | 205,887 | | | 0.023 |
| 1980 | | | 3,608 | | | 154,435 | | | 0.023 |
| 1981 | 2,755 | 2,530 | 5,285 | 112,569 | 36,727 | 149,296 | 0.024 | 0.069 | 0.035 |
| 1982 | 2,413 | 2,397 | 4,810 | 146,947 | 50,828 | 197,775 | 0.016 | 0.047 | 0.024 |
| 1983 | 4,064 | 5,110 | 9,174 | 197,324 | 51,195 | 248,519 | 0.021 | 0.100 | 0.037 |
| 1984 | 4,448 | 2,928 | 7,376 | 302,915 | 45,664 | 348,579 | 0.015 | 0.064 | 0.021 |
| 1985 | 5,010 | 3,045 | 8,055 | 248,517 | 45,936 | 294,453 | 0.020 | 0.066 | 0.027 |
| 1986 | 5,458 | 3,546 | 9,004 | 191,597 | 52,843 | 244,440 | 0.028 | 0.067 | 0.037 |
| 1987 | 6,361 | 5,966 | 12,327 | 231,511 | 79,329 | 310,840 | 0.027 | 0.075 | 0.040 |
| 1988 | 8,103 | 9,409 | 17,512 | 266,578 | 95,181 | 361,759 | 0.030 | 0.099 | 0.048 |
| 1989 | 3,799 | 5,328 | 9,127 | 231,085 | 97,966 | 329,051 | 0.016 | 0.054 | 0.028 |
| 1990 [a] | 2,439 | 3,808 | 6,247 | 190,743 | 101,223 | 291,966 | 0.013 | 0.038 | 0.022 |
| 1991 | 2,985 | 3,864 | 6,849 | 147,293 | 82,706 | 229,999 | 0.020 | 0.047 | 0.030 |
| 1992 [a] | 2,504 | 4,176 | 6,680 | 112,091 | 75,324 | 187,415 | 0.024 | 0.064 | 0.039 |
| 1993 | 7,413 | 7,866 | 15,279 | 201,695 | 92,213 | 293,908 | 0.037 | 0.085 | 0.052 |
| 1994 | 7,760 | 6,628 | 14,388 | 244,729 | 110,049 | 354,778 | 0.032 | 0.060 | 0.041 |
| 1995 | 4,914 | 5,211 | 10,125 | 200,397 | 123,585 | 323,982 | 0.025 | 0.042 | 0.031 |
| Mean | 4,695 | 4,787 | 7,825 | 201,733 | 76,051 | 233,176 | 0.023 | 0.065 | 0.034 |
| 1996 [b] | 2,131 | 3,853 | 5,984 | 128,438 | 110,057 | 238,495 | 0.017 | 0.035 | 0.025 |

[a] Harvest per hour only for periods open to retention of chinook salmon.

[b] Estimates with all of the creel data combined. The creel survey was stratified to provide estimates for upstream and downstream of the sonar counter. Stratified estimates may not sum to the same values shown here.

**Table 4.-Estimates by age class of the number of late-run chinook salmon harvested in the recreational fishery on the Kenai River, 1996.**

| | Age Class | | | | | |
|---|---|---|---|---|---|---|
| | 1.2 | 1.3 | 1.4 | 1.5 | Other | Total |
| Upstream of sonar counter[a] | | | | | | |
| **Males** | | | | | | |
| Sample Size | 10 | 29 | 55 | 1 | 1 | 96 |
| Percent | 4.3 | 12.4 | 23.5 | 0.4 | 0.4 | 41.0 |
| SE Percent | 1.3 | 2.2 | 2.8 | 0.4 | 0.4 | 3.2 |
| Harvest | 249 | 721 | 1,367 | 25 | 25 | 2,386 |
| SE Harvest | 79 | 134 | 184 | 25 | 25 | 243 |
| **Females** | | | | | | |
| Sample Size | 4 | 57 | 74 | 3 | 0 | 138 |
| Percent | 1.7 | 24.4 | 31.6 | 1.3 | 0.0 | 59.0 |
| SE Percent | 0.8 | 2.8 | 3.0 | 0.7 | 0.0 | 3.2 |
| Harvest | 99 | 1,417 | 1,839 | 75 | 0 | 3,430 |
| SE Harvest | 50 | 188 | 214 | 43 | 0 | 291 |
| **Combined** | | | | | | |
| Sample Size | 14 | 86 | 129 | 4 | 1 | 234 |
| Percent | 6.0 | 36.8 | 55.1 | 1.7 | 0.4 | 100.0 |
| SE Percent | 1.6 | 3.2 | 3.3 | 0.8 | 0.4 | |
| Harvest | 348 | 2,138 | 3,206 | 99 | 25 | 5,816 |
| SE Harvest | 93 | 230 | 282 | 50 | 25 | 379 |
| Downstream of sonar counter | | | | | | |
| **Males** | | | | | | |
| Sample Size | 10 | 29 | 55 | 1 | 1 | 96 |
| Percent | 4.3 | 12.4 | 23.5 | 0.4 | 0.4 | 41.0 |
| SE Percent | 1.3 | 2.2 | 2.8 | 0.4 | 0.4 | 3.2 |
| Harvest | 13 | 38 | 71 | 1 | 1 | 125 |
| SE Harvest | 6 | 15 | 26 | 1 | 1 | 44 |
| **Females** | | | | | | |
| Sample Size | 4 | 57 | 74 | 3 | 0 | 138 |
| Percent | 1.7 | 24.4 | 31.6 | 1.3 | 0.0 | 59.0 |
| SE Percent | 0.8 | 2.8 | 3.0 | 0.7 | 0.0 | 3.2 |
| Harvest | 5 | 74 | 96 | 4 | 0 | 179 |
| SE Harvest | 3 | 27 | 35 | 3 | 0 | 63 |
| **Combined** | | | | | | |
| Sample Size | 14 | 86 | 129 | 4 | 1 | 234 |
| Percent | 6.0 | 36.8 | 55.1 | 1.7 | 0.4 | 100.0 |
| SE Percent | 1.6 | 3.2 | 3.3 | 0.8 | 0.4 | |
| Harvest | 18 | 112 | 168 | 5 | 1 | 304 |
| SE Harvest | 8 | 40 | 59 | 3 | 1 | 106 |

[a] Location of harvest of sampled fish was unknown. Assume age structure of harvest was the same regardless of location of harvest.

**Table 5.-Estimates by age class of the number of late-run chinook salmon harvested in the recreational fishery on the Kenai River, 1986-1996.**

| | Age Class | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 2.2 | 2.3 | 2.4 | 2.5 | Other | Total |
| 1986 | | | | | | | | | | | | |
| Percent | 0.4 | 10.1 | 39.0 | 45.2 | 5.3 | | | | | | | 100.0 |
| Harvest | 37 | 913 | 3,507 | 4,072 | 475 | | | | | | | 9,004 |
| SE Harvest | 26 | 131 | 266 | 289 | 94 | | | | | | | 458 |
| 1987 | | | | | | | | | | | | |
| Percent | 0.4 | 1.0 | 22.8 | 72.7 | 3.1 | | | | | | | 100.0 |
| Harvest | 51 | 127 | 2,787 | 8,892 | 380 | | | | | | | 12,237 |
| SE Harvest | 36 | 57 | 292 | 611 | 99 | | | | | | | 769 |
| 1988 | | | | | | | | | | | | |
| Percent | 0.7 | 0.2 | 3.4 | 78.6 | 17.1 | | | | | | | 100.0 |
| Harvest | 126 | 42 | 589 | 13,766 | 2,989 | | | | | | | 17,512 |
| SE Harvest | 73 | 42 | 159 | 887 | 368 | | | | | | | 1,036 |
| 1989 | | | | | | | | | | | | |
| Percent | | 1.0 | 10.9 | 71.3 | 15.8 | | | | 1.0 | | | 100.0 |
| Harvest | | 90 | 994 | 6,507 | 1,446 | | | | 90 | | | 9,127 |
| SE Harvest | | 90 | 291 | 585 | 345 | | | | 90 | | | 582 |
| 1990 | | | | | | | | | | | | |
| Percent | 0.6 | 9.7 | 15.8 | 62.2 | 11.7 | | | | | | | 100.0 |
| Harvest | 37 | 605 | 989 | 3,883 | 733 | | | | | | | 6,247 |
| SE Harvest | 26 | 109 | 142 | 322 | 121 | | | | | | | 445 |
| 1991 | | | | | | | | | | | | |
| Percent | | 4.9 | 11.7 | 76.2 | 6.3 | | | 0.9 | | | | 100.0 |
| Harvest | | 338 | 799 | 5,221 | 430 | | | 61 | | | | 6,849 |
| SE Harvest | | 101 | 155 | 369 | 114 | | | 43 | | | | 410 |
| 1992 | | | | | | | | | | | | |
| Percent | 0.5 | 2.0 | 15.4 | 76.1 | 6.0 | | | | | | | 100.0 |
| Harvest | 33 | 133 | 1,030 | 5,085 | 399 | | | | | | | 6,680 |
| SE Harvest | 33 | 66 | 185 | 405 | 115 | | | | | | | 462 |
| 1993 | | | | | | | | | | | | |
| Percent | | 1.9 | 5.7 | 85.6 | 5.8 | | 0.6 | 0.3 | 0.1 | | | 100.0 |
| Harvest | | 288 | 865 | 13,084 | 887 | | 89 | 44 | 22 | | | 15,279 |
| SE Harvest | | 80 | 139 | 569 | 141 | | 44 | 31 | 22 | | | 620 |
| 1994 | | | | | | | | | | | | |
| Percent | 0.3 | 2.3 | 4.7 | 90.5 | 2.2 | | | | | | | 100.0 |
| Harvest | 36 | 325 | 681 | 13,026 | 320 | | | | | | | 14,388 |
| SE Harvest | 36 | 107 | 152 | 209 | 106 | | | | | | | 637 |
| 1995 | | | | | | | | | | | | |
| Percent | 0.6 | 7.0 | 9.8 | 71.9 | 10.7 | | | | | | | 100.0 |
| Harvest | 65 | 704 | 991 | 7,279 | 1,086 | | | | | | | 10,125 |
| SE Harvest | 38 | 124 | 153 | 424 | 162 | | | | | | | 511 |
| 1996[a] | | | | | | | | | | | | |
| Percent | 0.4 | 6.0 | 36.8 | 55.1 | 1.7 | | | | | | | 100.0 |
| Harvest | 25 | 348 | 2,138 | 3,206 | 99 | | | | | | | 5,816 |
| SE Harvest | 25 | 93 | 230 | 282 | 50 | | | | | | | 379 |

[a] Estimates for upstream of the sonar counter only.

**Table 6.-Estimates of the number of late-run chinook salmon mortalities attributable to hook-and-release fishing, Kenai River, 1986-1996.**

| Year | | Sport Catch | Sport Harvest | Number Released | SE Released | Percent Mortality[a] | SE Percent | Hook-and-Release Mortality | SE Mortality |
|---|---|---|---|---|---|---|---|---|---|
| 1986 | | 15,331 | 9,004 | 6,327 | 872 | 8.3 (E) | 3.39 | 522 | 220 |
| 1987 | | 16,701 | 12,237 | 4,464 | 1,214 | 8.3 (E) | 3.39 | 368 | 174 |
| 1988 | | 23,238 | 17,512 | 5,726 | 1,590 | 8.3 (E) | 3.39 | 472 | 225 |
| 1989 | | 12,210 | 9,127 | 3,083 | 1,097 | 10.6 (M) | 3.30 | 327 | 148 |
| 1990 | | 8,637 | 6,247 | 2,390 | 709 | 5.9 (M) | 3.30 | 141 | 65 |
| 1991 | | 8,091 | 6,849 | 1,242 | 631 | 8.3 (E) | 3.39 | 103 | 64 |
| 1992 | | 10,394 | 6,680 | 3,714 | 771 | 8.3 (E) | 3.39 | 308 | 139 |
| 1993 | | 19,660 | 15,279 | 4,381 | 1,002 | 8.3 (E) | 3.39 | 363 | 167 |
| 1994 | | 18,539 | 14,388 | 4,151 | 999 | 8.3 (E) | 3.39 | 344 | 160 |
| 1995 | | 13,899 | 10,125 | 3,774 | 825 | 8.3 (E) | 3.39 | 312 | 142 |
| 1996[b] | D | 436 | 304 | 132 | 163 | 8.3 (E) | 3.39 | 11 | 13 |
| | U | 6,592 | 5,816 | 776 | 562 | 8.3 (E) | 3.39 | 64 | 50 |

[a] E = estimated as the mean of the 1989 and 1990 mortality rates (Bendock and Alexandersdottir 1992) and M is the estimated rate during this study.

[b] D indicates downstream and U indicates upstream of the sonar counter.

**Table 7.-Estimates by age class of the number of late-run chinook salmon that died as a result of hook-and-release fishing in the recreational fishery on the Kenai River, 1996.**

| | Age Class | | | | | |
|---|---|---|---|---|---|---|
| | 1.2 | 1.3 | 1.4 | 1.5 | Other | Total |
| Upstream of sonar counter | | | | | | |
| Males | | | | | | |
| Sample Size[a] | 36 | 96 | 140 | 2 | 1 | 275 |
| Percent | 7.7 | 20.5 | 29.9 | 0.4 | 0.2 | 58.6 |
| SE Percent | 1.2 | 1.9 | 2.1 | 0.3 | 0.2 | 2.3 |
| Mortality | 5 | 13 | 19 | 0 | 0 | 38 |
| SE Mortality | 4 | 10 | 15 | 0 | 0 | 29 |
| Females | | | | | | |
| Sample Size[a] | 0 | 63 | 129 | 2 | 0 | 194 |
| Percent | 0.0 | 13.4 | 27.5 | 0.4 | 0.0 | 41.4 |
| SE Percent | 0.0 | 1.6 | 2.1 | 0.3 | 0.0 | 2.3 |
| Mortality | 0 | 9 | 18 | 1 | 0 | 26 |
| SE Mortality | 0 | 7 | 14 | 0 | 0 | 21 |
| Combined | | | | | | |
| Sample Size[a] | 36 | 159 | 269 | 4 | 1 | 469 |
| Percent | 7.7 | 33.9 | 57.4 | 0.9 | 0.2 | 100.0 |
| SE Percent | 1.2 | 2.2 | 2.3 | 0.4 | 0.2 | |
| Mortality | 5 | 22 | 37 | 1 | 0 | 64 |
| SE Mortality | 4 | 17 | 29 | 0 | 0 | 50 |
| Downstream of sonar counter | | | | | | |
| Males | | | | | | |
| Sample Size[a] | 36 | 96 | 140 | 2 | 1 | 275 |
| Percent | 7.7 | 20.5 | 29.9 | 0.4 | 0.2 | 58.6 |
| SE Percent | 1.2 | 1.9 | 2.1 | 0.3 | 0.2 | 2.3 |
| Mortality | 1 | 2 | 3 | 0 | 0 | 7 |
| SE Mortality | 1 | 3 | 4 | 0 | 0 | 8 |
| Females | | | | | | |
| Sample Size[a] | 0 | 63 | 129 | 2 | 0 | 194 |
| Percent | 0.0 | 13.4 | 27.5 | 0.4 | 0.0 | 41.4 |
| SE Percent | 0.0 | 1.6 | 2.1 | 0.3 | 0.0 | 2.3 |
| Mortality | 0 | 2 | 3 | 0 | 0 | 5 |
| SE Mortality | 0 | 2 | 4 | 0 | 0 | 5 |
| Combined | | | | | | |
| Sample Size[a] | 36 | 159 | 269 | 4 | 1 | 469 |
| Percent | 7.7 | 33.9 | 57.4 | 0.9 | 0.2 | 100.0 |
| SE Percent | 1.2 | 2.2 | 2.3 | 0.4 | 0.2 | |
| Mortality | 1 | 4 | 6 | 0 | 0 | 11 |
| SE Mortality | 1 | 4 | 7 | 0 | 0 | 13 |

[a] Age/sex composition of released fish that died as a result of hook-and-release fishing was assumed equal to the age/sex composition of the inriver return during strata 7/1-7/23 and 7/24-7/31 combined.

(SE = 1,059) fish (Burwen and Bosch *In prep*; Table 8). Large numbers of pink salmon *O. gorbuscha* holding in the sonar beam made counting of chinook salmon unreliable after 31 July. The 1996 inriver return was 30% larger than the 1984-1995 mean of 41,780 fish (Table 1).

A sample of 469 late-run chinook salmon were captured with gillnets to estimate age composition of the inriver return. There was no significant ($\chi^2$ = 2.3, df = 1, P = 0.13) difference in the age composition between 1 July-23 July and 24 July-15 August for the two age classes making up over 90% of the return. The inriver return was predominantly age 1.4 (57%) followed by age classes 1.3, 1.2, and 1.5 (34%, 8%, 1%, respectively) (Table 9). Age-1.4 fish have historically dominated the total inriver return (Table 10).

## ESCAPEMENT AND TOTAL RETURN

Spawning escapement by age class was estimated by subtracting total inriver fishing mortality upstream of the sonar counter from the sonar count. In 1996, an estimated 48,054 (SE = 1,126) chinook salmon escaped all fisheries (Table 11). The majority (58%) of these spawners were age class 1.4. This age class has been the predominant spawning age class since estimates were first made in 1986.

The total return of late-run chinook salmon to the Kenai River is the sum of the commercial, recreational, personal use and subsistence harvests plus the escapement. The estimated total return of chinook salmon to the Kenai River in 1996 was 66,286 (SE = 1,059) fish (Tables 1 and 10).

## BROOD RELATIONSHIPS

Age components of measured returns are presented in Table 12 and a summary of the production from each brood year appears in Table 13. Production of 19,581 fish from the 1989 escapement, the smallest measured so far, produced the largest return-per-spawner (RPS) ratio (2.26) with age-7 fish to return in 1997. The 1990 escapement of 27,086 chinook salmon has the third largest RPS ratio, with ages 7 and 8 still to return. The 1991 escapement of 27,662 chinook salmon also appears to be producing very well, with an RPS ratio of 1.32 and ages 6-8 yet to return.

## SIBLING RELATIONSHIPS

Sibling return ratios (Sonnichsen and Alexandersdottir 1991) have been used to forecast returns since 1990 (Table 14). Observed returns have ranged from 28% less than the forecasted value to 37% greater than the forecasted value, averaging within 3% of the anticipated return (Table 15). The 1997 forecast for the Kenai River late run is 120,514 (SE = 32,788) chinook salmon (Table 15).

## MIGRATORY TIMING MODELS

The mean timing model used to predict the inriver return performed well in 1996 (Figure 4). Cumulative proportions by date for 1996 remained within the 1985-1995 95% confidence interval throughout the late run, except for 25-30 July (Figure 5). The mean timing model was the basis for extending the recreational fishery into August.

The models used to predict end of season (31 July) harvest and catch did not perform as well as in the past. The fishery, in general, appeared to be quite different than previous seasons. Daily projections of end of season harvest and catch did not appear to be reliable until 20 July (Figure 6). The final escapement is predicted by combining the inriver return, harvest, and catch models. The erratic fishery and the fact that the August component of the return was not assessed resulted in less accurate projections of the final escapement (Figure 7).

## Table 8.-Historical sonar counts of chinook salmon in the Kenai River during the late run, 1987-1996.

| | 1987 Counts | | 1988 Counts | | 1989 Counts | | 1990 Counts | | 1991 Counts | | 1992 Counts | | 1993 Counts | | 1994 Counts | | 1995 Counts | | 1996 Counts | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Daily | Cum | Daily | Cum | Daily | Cum | Daily | Cum | Daily | Cum | Daily | Cum | Daily | Cum | Daily | Cum | Daily | Cum | Daily | Cum |
| 7/01 | 507 | 507 | 526 | 526 | 769 | 769 | 578 | 578 | 267 | 267 | 364 | 364 | 539 | 539 | 663 | 663 | 350 | 350 | 341 | 341 |
| 7/02 | 429 | 936 | 404 | 930 | 489 | 1,258 | 305 | 883 | 300 | 567 | 297 | 661 | 432 | 971 | 342 | 1,005 | 398 | 748 | 240 | 581 |
| 7/03 | 405 | 1,341 | 398 | 1,328 | 353 | 1,611 | 486 | 1,369 | 333 | 900 | 320 | 981 | 325 | 1,296 | 625 | 1,630 | 353 | 1,101 | 303 | 884 |
| 7/04 | 628 | 1,969 | 292 | 1,620 | 566 | 2,177 | 436 | 1,805 | 519 | 1,419 | 198 | 1,179 | 397 | 1,693 | 858 | 2,488 | 439 | 1,540 | 393 | 1,277 |
| 7/05 | 596 | 2,565 | 482 | 2,102 | 1,106 | 3,283 | 853 | 2,658 | 316 | 1,735 | 225 | 1,404 | 429 | 2,122 | 705 | 3,193 | 667 | 2,207 | 1,067 | 2,344 |
| 7/06 | 523 | 3,088 | 654 | 2,756 | 879 | 4,162 | 795 | 3,453 | 242 | 1,977 | 331 | 1,735 | 884 | 3,006 | 1,069 | 4,262 | 720 | 2,927 | 879 | 3,223 |
| 7/07 | 769 | 3,857 | 379 | 3,135 | 680 | 4,842 | 929 | 4,382 | 186 | 2,163 | 247 | 1,982 | 1,572 | 4,578 | 1,050 | 5,312 | 931 | 3,858 | 780 | 4,003 |
| 7/08 | 483 | 4,340 | 725 | 3,860 | 776 | 5,618 | 432 | 4,814 | 139 | 2,302 | 170 | 2,152 | 1,855 | 6,433 | 655 | 5,967 | 417 | 4,275 | 867 | 4,870 |
| 7/09 | 384 | 4,724 | 471 | 4,331 | 1,404 | 7,022 | 309 | 5,123 | 393 | 2,695 | 205 | 2,357 | 1,876 | 8,309 | 744 | 6,711 | 519 | 4,794 | 768 | 5,638 |
| 7/10 | 314 | 5,038 | 1,732 | 6,063 | 560 | 7,582 | 359 | 5,482 | 481 | 3,176 | 221 | 2,578 | 820 | 9,129 | 1,275 | 7,986 | 450 | 5,244 | 1,023 | 6,661 |
| 7/11 | 340 | 5,378 | 1,507 | 7,570 | 2,010 | 9,592 | 778 | 6,260 | 403 | 3,579 | 143 | 2,721 | 1,238 | 10,367 | 509 | 8,495 | 325 | 5,569 | 1,146 | 7,807 |
| 7/12 | 751 | 6,129 | 1,087 | 8,657 | 2,763 | 12,355 | 557 | 6,817 | 330 | 3,909 | 1,027 | 3,748 | 676 | 11,043 | 828 | 9,323 | 276 | 5,845 | 714 | 8,521 |
| 7/13 | 747 | 6,876 | 2,251 | 10,908 | 910 | 13,265 | 1,175 | 7,992 | 308 | 4,217 | 605 | 4,353 | 3,345 | 14,388 | 1,066 | 10,389 | 570 | 6,415 | 1,128 | 9,649 |
| 7/14 | 761 | 7,637 | 2,370 | 13,278 | 2,284 | 15,549 | 1,481 | 9,473 | 572 | 4,789 | 689 | 5,042 | 3,177 | 17,565 | 1,332 | 11,721 | 714 | 7,129 | 4,437 | 14,086 |
| 7/15 | 913 | 8,550 | 2,405 | 15,683 | 1,111 | 16,660 | 1,149 | 10,622 | 542 | 5,331 | 745 | 5,787 | 2,233 | 19,798 | 2,211 | 13,932 | 750 | 7,879 | 3,222 | 17,308 |
| 7/16 | 1,466 | 10,016 | 1,259 | 16,942 | 1,344 | 18,004 | 1,011 | 11,633 | 1,029 | 6,360 | 703 | 6,490 | 2,329 | 22,127 | 3,825 | 17,757 | 1,962 | 9,841 | 3,494 | 20,802 |
| 7/17 | 1,353 | 11,369 | 1,520 | 18,462 | 963 | 18,967 | 2,395 | 14,028 | 2,052 | 8,412 | 570 | 7,060 | 2,037 | 24,164 | 4,692 | 22,449 | 1,128 | 10,969 | 2,253 | 23,055 |
| 7/18 | 841 | 12,210 | 2,180 | 20,642 | 1,382 | 20,349 | 2,113 | 16,141 | 3,114 | 11,526 | 853 | 7,913 | 1,438 | 25,602 | 2,157 | 24,606 | 3,942 | 14,911 | 2,820 | 25,875 |
| 7/19 | 2,071 | 14,281 | 1,724 | 22,366 | 425 | 20,774 | 1,363 | 17,504 | 1,999 | 13,525 | 1,128 | 9,041 | 715 | 26,317 | 3,493 | 28,099 | 4,692 | 19,603 | 2,236 | 28,111 |
| 7/20 | 3,709 | 17,990 | 2,670 | 25,036 | 820 | 21,594 | 1,499 | 19,003 | 1,422 | 14,947 | 1,144 | 10,185 | 1,348 | 27,665 | 2,317 | 30,416 | 4,779 | 24,382 | 2,609 | 30,720 |
| 7/21 | 3,737 | 21,727 | 3,170 | 28,206 | 916 | 22,510 | 787 | 19,790 | 1,030 | 15,977 | 799 | 10,984 | 981 | 28,646 | 1,695 | 32,111 | 3,132 | 27,514 | 3,435 | 34,155 |
| 7/22 | 1,835 | 23,562 | 1,302 | 29,508 | 583 | 23,093 | 573 | 20,363 | 1,050 | 17,027 | 619 | 11,603 | 1,166 | 29,812 | 1,386 | 33,497 | 3,465 | 30,979 | 2,250 | 36,405 |
| 7/23 | 1,700 | 25,262 | 1,502 | 31,010 | 756 | 23,849 | 642 | 21,005 | 2,632 | 19,659 | 1,449 | 13,052 | 1,163 | 30,975 | 1,050 | 34,547 | 2,421 | 33,400 | 3,050 | 39,455 |
| 7/24 | 2,998 | 28,260 | 1,386 | 32,396 | 783 | 24,632 | 1,106 | 22,111 | 2,204 | 21,863 | 711 | 13,763 | 1,344 | 32,319 | 1,232 | 35,779 | 831 | 34,231 | 3,634 | 43,089 |
| 7/25 | 1,915 | 30,175 | 999 | 33,395 | 495 | 25,127 | 810 | 22,921 | 1,306 | 23,169 | 1,713 | 15,476 | 2,245 | 34,564 | 1,412 | 37,191 | 840 | 35,071 | 3,240 | 46,329 |
| 7/26 | 1,968 | 32,143 | 924 | 34,319 | 432 | 25,559 | 671 | 23,592 | 1,216 | 24,385 | 1,296 | 16,772 | 1,421 | 35,985 | 1,378 | 38,569 | 1,683 | 36,754 | 2,319 | 48,648 |
| 7/27 | 1,523 | 33,666 | 960 | 35,279 | 618 | 26,177 | 755 | 24,347 | 1,195 | 25,580 | 1,561 | 18,333 | 1,952 | 37,937 | 1,244 | 39,813 | 1,806 | 38,560 | 1,782 | 50,430 |
| 7/28 | 2,101 | 35,767 | 1,398 | 36,677 | 538 | 26,715 | 603 | 24,950 | 1,901 | 27,481 | 1,957 | 20,290 | 1,915 | 39,852 | 2,180 | 41,993 | 789 | 39,349 | 861 | 51,291 |
| 7/29 | 1,923 | 37,690 | 1,400 | 38,077 | 441 | 27,156 | 546 | 25,496 | 1,146 | 28,627 | 1,533 | 21,823 | 1,363 | 41,215 | 1,327 | 43,320 | 558 | 39,907 | 474 | 51,765 |
| 7/30 | 2,595 | 40,285 | 1,158 | 39,235 | 391 | 27,547 | 382 | 25,878 | 791 | 29,418 | 1,198 | 23,021 | 1,628 | 42,843 | 1,776 | 45,096 | 510 | 40,417 | 621 | 52,386 |
| 7/31 | 2,372 | 42,657 | 910 | 40,145 | 383 | 27,930 | 316 | 26,194 | 974 | 30,392 | 951 | 23,972 | 862 | 43,705 | 1,808 | 46,904 | 480 | 40,897 | 1,548 | 53,934 |
| 8/01 | 470 | 43,127 | 925 | 41,070 | 351 | 28,281 | 393 | 26,587 | 897 | 31,289 | 921 | 24,893 | 767 | 44,472 | 1,037 | 47,941 | 474 | 41,371 | | |
| 8/02 | 314 | 43,441 | 781 | 41,851 | 201 | 28,482 | 388 | 26,975 | 867 | 32,156 | 1,018 | 25,911 | 613 | 45,085 | 1,226 | 49,167 | 369 | 41,740 | | |
| 8/03 | 263 | 43,704 | 989 | 42,840 | 132 | 28,614 | 533 | 27,508 | 392 | 32,548 | 837 | 26,748 | 337 | 45,422 | 1,081 | 50,248 | 447 | 42,187 | | |
| 8/04 | 835 | 44,539 | 1,524 | 44,364 | 142 | 28,756 | 717 | 28,225 | 331 | 32,879 | 862 | 27,610 | 463 | 45,885 | 658 | 50,906 | 519 | 42,706 | | |
| 8/05 | 904 | 45,443 | 1,091 | 45,455 | 107 | 28,863 | 723 | 28,948 | 174 | 33,053 | 861 | 28,471 | 711 | 46,596 | 536 | 51,442 | 404 | 43,110 | | |
| 8/06 | 648 | 46,091 | 1,333 | 46,788 | 107 | 28,970 | 552 | 29,500 | 343 | 33,396 | 654 | 29,125 | 1,079 | 47,675 | 1,042 | 52,484 | 408 | 43,518 | | |
| 8/07 | 694 | 46,785 | 1,186 | 47,974 | 65 | 29,035 | 516 | 30,016 | 618 | 34,014 | 558 | 29,683 | 656 | 48,331 | 797 | 53,281 | 279 | 43,797 | | |
| 8/08 | 658 | 47,443 | 1,449 | 49,423 | | | 682 | 30,698 | 600 | 34,614 | 217 | 29,900 | 669 | 49,000 | | | 267 | 44,064 | | |
| 8/09 | 368 | 47,811 | 1,132 | 50,555 | | | 679 | 31,377 | | | 165 | 30,065 | 422 | 49,422 | | | 272 | 44,336 | | |
| 8/10 | 312 | 48,123 | 755 | 51,310 | | | 678 | 32,055 | | | 249 | 30,314 | 252 | 49,674 | | | | | | |
| 8/11 | | 48,123 | 698 | 52,008 | | | 547 | 32,602 | | | | | | | | | | | | |
| 8/12 | | | | | | | 362 | 32,964 | | | | | | | | | | | | |
| 8/13 | | | | | | | 221 | 33,185 | | | | | | | | | | | | |
| 8/14 | | | | | | | 139 | 33,324 | | | | | | | | | | | | |
| 8/15 | | | | | | | 150 | 33,474 | | | | | | | | | | | | |
| Total | | 48,123 | | 52,008 | | 29,035 | | 33,474 | | 34,614 | | 30,314 | | 49,674 | | 53,281 | | 44,336 | | 53,934 |

**Table 9.-Estimates by age class of the number of late-run chinook salmon in the inriver return to the Kenai River, 1996.**

| | Age Class | | | | | |
|---|---|---|---|---|---|---|
| | 1.2 | 1.3 | 1.4 | 1.5 | Other | Total |
| Sonar count | | | | | | |
| **Males** | | | | | | |
| Sample Size | 36 | 96 | 140 | 2 | 1 | 275 |
| Percent | 7.7 | 20.5 | 29.9 | 0.4 | 0.2 | 58.6 |
| SE Percent | 1.2 | 1.9 | 2.1 | 0.3 | 0.2 | 2.3 |
| Return | 4,140 | 11,040 | 16,100 | 230 | 115 | 31,624 |
| SE Return | 668 | 1,029 | 1,183 | 162 | 115 | 1,374 |
| **Females** | | | | | | |
| Sample Size | 0 | 63 | 129 | 2 | 0 | 194 |
| Percent | 0.0 | 13.4 | 27.5 | 0.4 | 0.0 | 41.4 |
| SE Percent | 0.0 | 1.6 | 2.1 | 0.3 | 0.0 | 2.3 |
| Return | 0 | 7,245 | 14,835 | 230 | 0 | 22,310 |
| SE Return | 0 | 862 | 1,150 | 162 | 0 | 1,303 |
| **Combined** | | | | | | |
| Sample Size | 36 | 159 | 269 | 4 | 1 | 469 |
| Percent | 7.7 | 33.9 | 57.4 | 0.9 | 0.2 | 100.0 |
| SE Percent | 1.2 | 2.2 | 2.3 | 0.4 | 0.2 | |
| Return | 4,140 | 18,285 | 30,934 | 460 | 115 | 53,934 |
| SE Return | 668 | 1,233 | 1,373 | 229 | 115 | 1,054 |
| Sport harvest downstream of sonar | | | | | | |
| **Males** | | | | | | |
| Harvest | 13 | 38 | 71 | 1 | 1 | 125 |
| SE Harvest | 6 | 15 | 26 | 1 | 1 | 44 |
| **Females** | | | | | | |
| Harvest | 5 | 74 | 96 | 4 | 0 | 179 |
| SE Harvest | 3 | 27 | 35 | 3 | 0 | 63 |
| **Combined** | | | | | | |
| Harvest | 18 | 112 | 168 | 5 | 1 | 304 |
| SE Harvest | 8 | 40 | 59 | 3 | 1 | 106 |
| Hook and release mortality downstream of sonar | | | | | | |
| **Males** | | | | | | |
| Mortality | 1 | 2 | 3 | 0 | 0 | 7 |
| SE Mortality | 1 | 3 | 4 | 0 | 0 | 8 |
| **Females** | | | | | | |
| Mortality | 0 | 2 | 3 | 0 | 0 | 5 |
| SE Mortality | 0 | 2 | 4 | 0 | 0 | 5 |
| **Combined** | | | | | | |
| Mortality | 1 | 4 | 6 | 0 | 0 | 11 |
| SE Mortality | 1 | 4 | 7 | 0 | 0 | 13 |
| Total inriver return | | | | | | |
| **Males** | | | | | | |
| Percent | 7.7 | 20.4 | 29.8 | 0.4 | 0.2 | 58.5 |
| Return | 4,154 | 11,080 | 16,174 | 231 | 116 | 31,756 |
| SE Return | 668 | 1,029 | 1,184 | 162 | 115 | 1,375 |
| **Females** | | | | | | |
| Percent | 0.0 | 13.5 | 27.5 | 0.4 | 0.0 | 41.5 |
| Return | 5 | 7,321 | 14,934 | 234 | 0 | 22,494 |
| SE Return | 3 | 862 | 1,151 | 163 | 0 | 1,304 |
| **Combined** | | | | | | |
| Percent | 7.7 | 33.9 | 57.3 | 0.9 | 0.2 | 100.0 |
| Return | 4,159 | 18,401 | 31,108 | 465 | 116 | 54,249 |
| SE Return | 669 | 1,234 | 1,374 | 229 | 115 | 1,059 |

**Table 10.-Estimates by age class of the number of late-run chinook salmon in the total return to the Kenai River, 1986-1996.**

| | Age Class | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.2 | 0.3 | 0.4 | 0.5 | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | Total |
| 1986 | | | | | | | | | | | | | | | | |
| Percent | 0.1 | 0.1 | 0.0 | 0.0 | 0.3 | 15.1 | 44.2 | 36.4 | 3.5 | 0.0 | 0.1 | 0.1 | 0.2 | 0.1 | 0.0 | 100.0 |
| Return | 43 | 43 | 22 | 22 | 260 | 12,017 | 35,314 | 29,039 | 2,774 | 22 | 43 | 43 | 152 | 43 | 0 | 79,837 |
| SE Return | 24 | 24 | 17 | 17 | 60 | 3,436 | 9,106 | 6,482 | 776 | 17 | 24 | 24 | 46 | 24 | | 19,458 |
| 1987 | | | | | | | | | | | | | | | | |
| Percent | 0 | 0 | 0 | 0 | 0.5 | 4.9 | 30.2 | 63.0 | 1.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 100.0 |
| Return | 0 | 0 | 0 | 0 | 361 | 3,635 | 22,427 | 46,812 | 775 | 99 | 51 | 44 | 97 | 58 | 0 | 74,359 |
| SE Return | | | | | 75 | 315 | 796 | 823 | 173 | 70 | 51 | 23 | 57 | 50 | | 0 |
| 1988 | | | | | | | | | | | | | | | | |
| Percent | 0 | 0 | 0.1 | 0 | 0.7 | 3.3 | 6.0 | 75.0 | 14.8 | 0 | 0 | 0.1 | 0.0 | 0.1 | 0.0 | 100.0 |
| Return | 0 | 0 | 35 | 0 | 454 | 2,235 | 4,116 | 51,233 | 10,121 | 0 | 0 | 46 | 15 | 101 | 0 | 68,356 |
| SE Return | | | 17 | | 72 | 241 | 375 | 820 | 735 | | | 23 | 13 | 36 | | 0 |
| 1989 | | | | | | | | | | | | | | | | |
| Percent | 0 | 0 | 0 | 0 | 0.3 | 12.2 | 15.0 | 60.3 | 11.8 | 0.2 | 0.0 | 0.1 | 0 | 0.0 | 0.0 | 100.0 |
| Return | 0 | 0 | 0 | 0 | 108 | 5,053 | 6,194 | 24,908 | 4,888 | 76 | 0 | 34 | 0 | 13 | 0 | 41,274 |
| SE Return | | | | | 38 | 438 | 468 | 662 | 456 | 69 | | 24 | | 13 | | 0 |
| 1990 | | | | | | | | | | | | | | | | |
| Percent | 0 | 0.0 | 0.0 | 0 | 0.2 | 14.5 | 16.6 | 63.6 | 4.6 | 0 | 0.1 | 0.1 | 0.1 | 0.2 | 0.0 | 100.0 |
| Return | 0 | 11 | 11 | 0 | 65 | 5,749 | 6,572 | 25,237 | 1,841 | 0 | 45 | 23 | 23 | 79 | 0 | 39,656 |
| SE Return | | 10 | 10 | | 22 | 480 | 519 | 655 | 307 | | 19 | 14 | 14 | 26 | | 0 |
| 1991 | | | | | | | | | | | | | | | | |
| Percent | 0.0 | 0 | 0.1 | 0 | 0.1 | 10.3 | 18.5 | 64.4 | 5.8 | 0 | 0.0 | 0 | 0.6 | 0.0 | 0.0 | 100.0 |
| Return | 15 | 0 | 31 | 0 | 46 | 4,291 | 7,687 | 26,732 | 2,396 | 0 | 15 | 0 | 261 | 15 | 0 | 41,489 |
| SE Return | 15 | | 22 | | 27 | 526 | 721 | 903 | 479 | | 15 | | 154 | 15 | | 0 |
| 1992 | | | | | | | | | | | | | | | | |
| Percent | 0 | 0 | 0 | 0 | 0.8 | 9.7 | 19.7 | 66.5 | 2.8 | 0 | 0 | 0.2 | 0.3 | 0.0 | 0.0 | 100.0 |
| Return | 0 | 0 | 0 | 0 | 347 | 4,311 | 8,746 | 29,515 | 1,230 | 0 | 0 | 82 | 123 | 19 | 0 | 44,373 |
| SE Return | | | | | 83 | 468 | 649 | 766 | 267 | | | 41 | 50 | 19 | | 0 |
| 1993 | | | | | | | | | | | | | | | | |
| Percent | 0 | 0 | 0 | 0 | 0.8 | 9.4 | 15.9 | 68.0 | 5.3 | 0 | 0 | 0.0 | 0.6 | 0.1 | 0.0 | 100.0 |
| Return | 0 | 0 | 0 | 0 | 528 | 6,367 | 10,770 | 46,188 | 3,570 | 0 | 0 | 19 | 406 | 79 | 0 | 67,927 |
| SE Return | | | | | 99 | 739 | 950 | 1,215 | 624 | | | 19 | 207 | 39 | | 0 |
| 1994 | | | | | | | | | | | | | | | | |
| Percent | 0 | 0 | 0 | 0 | 0.9 | 7.2 | 12.1 | 74.2 | 4.5 | 0 | 0 | 0.1 | 0.1 | 0.9 | 0.0 | 100.0 |
| Return | 0 | 0 | 0 | 0 | 625 | 5,218 | 8,758 | 53,663 | 3,262 | 10 | 0 | 44 | 77 | 675 | 0 | 72,332 |
| SE Return | | | | | 73 | 610 | 837 | 1,071 | 530 | 10 | 0 | 22 | 29 | 389 | | 0 |
| 1995 | | | | | | | | | | | | | | | | |
| Percent | 0 | 0 | 0 | 0 | 0.7 | 22.4 | 23.9 | 46.9 | 5.5 | 0 | 0 | 0.2 | 0.0 | 0.4 | 0.0 | 100.0 |
| Return | 0 | 0 | 0 | 0 | 398 | 13,357 | 14,250 | 27,965 | 3,270 | 0 | 0 | 101 | 15 | 252 | 7 | 59,615 |
| SE Return | 0 | 0 | 0 | 0 | 55 | 1,298 | 1,280 | 1,558 | 701 | 0 | 0 | 30 | 11 | 216 | 7 | 65 |
| 1996 | | | | | | | | | | | | | | | | |
| Percent | 0 | 0 | 0 | 0 | 0.7 | 9.1 | 34.1 | 54.6 | 1.0 | 0 | 0 | 0.0 | 0.3 | 0.1 | 0.0 | 100.0 |
| Return | 0 | 0 | 0 | 0 | 490 | 6,040 | 22,631 | 36,224 | 639 | 0 | 0 | 19 | 187 | 49 | 7 | 66,286 |
| SE Return | 0 | 0 | 0 | 0 | 121 | 674 | 1,240 | 1,380 | 232 | 0 | 0 | 9 | 35 | 18 | 7 | 1,059 |

**Table 11.-Estimates by age class of the number of late-run chinook salmon in the spawning escapement to the Kenai River, 1986-1996.**

| | Age Class | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 2.1 | 2.3 | 2.4 | Total |
| 1986 | | | | | | | | | | |
| Inriver Return | 0 | 7,009 | 27,141 | 21,413 | 2,000 | 0 | 0 | 0 | 0 | 57,563 |
| SE Return | 0 | 3,428 | 9,101 | 6,474 | 769 | 0 | 0 | 0 | 0 | 19,457 |
| Harvest | 37 | 913 | 3,507 | 4,072 | 475 | 0 | 0 | 0 | 0 | 9,004 |
| SE Harvest | 26 | 131 | 266 | 289 | 94 | 0 | 0 | 0 | 0 | 458 |
| H&R[a] Mortality | 0 | 63 | 229 | 207 | 23 | 0 | 0 | 0 | 0 | 522 |
| SE H&R | 0 | 27 | 96 | 87 | 10 | 0 | 0 | 0 | 0 | 220 |
| Escapement[b] | 0 | 6,033 | 23,405 | 17,134 | 1,502 | 0 | 0 | 0 | 0 | 48,037 |
| SE Escapement | 0 | 3,431 | 9,105 | 6,481 | 775 | 0 | 0 | 0 | 0 | 19,464 |
| 1987 | | | | | | | | | | |
| Inriver Return | 0 | 898 | 13,407 | 33,119 | 500 | 99 | 50 | 0 | 50 | 48,123 |
| SE Return | 0 | 209 | 696 | 719 | 157 | 70 | 50 | 0 | 50 | 0 |
| Harvest | 51 | 127 | 2,787 | 8,892 | 380 | 0 | 0 | 0 | 0 | 12,237 |
| SE Harvest | 36 | 57 | 292 | 611 | 99 | 0 | 0 | 0 | 0 | 769 |
| H&R[a] Mortality | 0 | 7 | 103 | 253 | 4 | 1 | 0 | 0 | 0 | 368 |
| SE H&R | 0 | 4 | 49 | 120 | 2 | 1 | 0 | 0 | 0 | 174 |
| Escapement[b] | 0 | 764 | 10,517 | 23,974 | 116 | 98 | 50 | 0 | 50 | 35,518 |
| SE Escapement | 0 | 217 | 756 | 951 | 186 | 70 | 50 | 0 | 50 | 788 |
| 1988 | | | | | | | | | | |
| Inriver Return | 0 | 628 | 1,888 | 39,860 | 9,632 | 0 | 0 | 0 | 0 | 52,008 |
| SE Return | 0 | 198 | 340 | 793 | 732 | 0 | 0 | 0 | 0 | 0 |
| Harvest | 126 | 42 | 589 | 13,766 | 2,989 | 0 | 0 | 0 | 0 | 17,512 |
| SE Harvest | 73 | 42 | 159 | 887 | 368 | 0 | 0 | 0 | 0 | 1,036 |
| H&R[a] Mortality | 0 | 6 | 18 | 367 | 81 | 0 | 0 | 0 | 0 | 472 |
| SE H&R | 0 | 3 | 9 | 175 | 39 | 0 | 0 | 0 | 0 | 225 |
| Escapement[b] | 0 | 580 | 1,281 | 25,727 | 6,562 | 0 | 0 | 0 | 0 | 34,024 |
| SE Escapement | 0 | 202 | 375 | 1,203 | 820 | 0 | 0 | 0 | 0 | 1,060 |
| 1989 | | | | | | | | | | |
| Inriver Return | 8 | 3,129 | 3,734 | 18,366 | 3,722 | 76 | 0 | 0 | 0 | 29,035 |
| SE Return | 8 | 409 | 437 | 629 | 440 | 69 | 0 | 0 | 0 | 0 |
| Harvest | 0 | 90 | 994 | 6,507 | 1,446 | 0 | 0 | 0 | 90 | 9,127 |
| SE Harvest | 0 | 90 | 291 | 585 | 345 | 0 | 0 | 0 | 90 | 582 |
| H&R[a] Mortality | 1 | 34 | 40 | 211 | 40 | 1 | 0 | 0 | 0 | 327 |
| SE H&R | 1 | 16 | 19 | 96 | 18 | 1 | 0 | 0 | 0 | 148 |
| Escapement[b] | 7 | 3,005 | 2,700 | 11,648 | 2,236 | 75 | 0 | 0 | 0 | 19,581 |
| SE Escapement | 8 | 419 | 525 | 864 | 559 | 69 | 0 | 0 | 0 | 601 |
| 1990 | | | | | | | | | | |
| Inriver Return | 0 | 4,204 | 4,934 | 22,808 | 1,528 | 0 | 0 | 0 | 0 | 33,474 |
| SE Return | 0 | 471 | 510 | 647 | 304 | 0 | 0 | 0 | 0 | 0 |
| Harvest | 37 | 605 | 989 | 3,883 | 733 | 0 | 0 | 0 | 0 | 6,247 |
| SE Harvest | 26 | 109 | 142 | 322 | 121 | 0 | 0 | 0 | 0 | 445 |
| H&R[a] Mortality | 0 | 17 | 21 | 97 | 6 | 0 | 0 | 0 | 0 | 141 |
| SE H&R | 0 | 8 | 10 | 45 | 3 | 0 | 0 | 0 | 0 | 65 |
| Escapement[b] | 0 | 3,582 | 3,924 | 18,828 | 789 | 0 | 0 | 0 | 0 | 27,086 |
| SE Escapement | 0 | 484 | 529 | 724 | 327 | 0 | 0 | 0 | 0 | 450 |
| 1991 | | | | | | | | | | |
| Inriver Return | 0 | 2,580 | 5,482 | 24,080 | 2,257 | 0 | 0 | 215 | 0 | 34,614 |
| SE Return | 0 | 507 | 705 | 889 | 477 | 0 | 0 | 152 | 0 | 0 |
| Harvest | 0 | 338 | 799 | 5,221 | 430 | 0 | 0 | 61 | 0 | 6,849 |
| SE Harvest | 0 | 101 | 155 | 369 | 114 | 0 | 0 | 43 | 0 | 410 |
| H&R[a] Mortality | 0 | 5 | 12 | 79 | 6 | 0 | 0 | 1 | 0 | 103 |
| SE H&R | 0 | 3 | 8 | 49 | 4 | 0 | 0 | 1 | 0 | 64 |
| Escapement[b] | 0 | 2,237 | 4,671 | 18,780 | 1,821 | 0 | 0 | 153 | 0 | 27,662 |
| SE Escapement | 0 | 517 | 722 | 964 | 490 | 0 | 0 | 158 | 0 | 415 |

-continued-

**Table 11.-Page 2 of 2.**

| | Age Class | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 2.1 | 2.3 | 2.4 | Total |
| 1992 | | | | | | | | | | |
| Inriver Return | 0 | 2,206 | 4,863 | 22,546 | 699 | 0 | 0 | 0 | 0 | 30,314 |
| SE Return | 0 | 427 | 603 | 718 | 247 | 0 | 0 | 0 | 0 | 0 |
| Harvest | 33 | 133 | 1,030 | 5,085 | 399 | 0 | 0 | 0 | 0 | 6,680 |
| SE Harvest | 33 | 66 | 185 | 405 | 115 | 0 | 0 | 0 | 0 | 462 |
| H&R[a] Mortality | 0 | 21 | 49 | 231 | 7 | 0 | 0 | 0 | 0 | 308 |
| SE H&R | 0 | 10 | 23 | 105 | 4 | 0 | 0 | 0 | 0 | 139 |
| Escapement[b] | 0 | 2,052 | 3,784 | 17,230 | 293 | 0 | 0 | 0 | 0 | 23,326 |
| SE Escapement | 0 | 432 | 631 | 831 | 272 | 0 | 0 | 0 | 0 | 482 |
| 1993 | | | | | | | | | | |
| Inriver Return | 0 | 4,012 | 6,985 | 35,565 | 2,825 | 0 | 0 | 287 | 0 | 49,674 |
| SE Return | 0 | 712 | 919 | 1,180 | 613 | 0 | 0 | 202 | 0 | 0 |
| Harvest | 0 | 288 | 865 | 13,084 | 887 | 0 | 89 | 44 | 22 | 15,279 |
| SE Harvest | 0 | 80 | 139 | 569 | 141 | 0 | 44 | 31 | 22 | 620 |
| H&R[a] Mortality | 0 | 45 | 64 | 236 | 15 | 0 | 2 | 1 | 0 | 363 |
| SE H&R | 0 | 22 | 31 | 109 | 8 | 0 | 2 | 1 | 0 | 167 |
| Escapement[b] | 0 | 3,679 | 6,056 | 22,245 | 1,923 | 0 | 0 | 242 | 0 | 34,032 |
| SE Escapement | 0 | 717 | 930 | 1,315 | 629 | 0 | 0 | 204 | 0 | 642 |
| 1994 | | | | | | | | | | |
| Inriver Return | 0 | 2,954 | 6,041 | 41,714 | 2,187 | 0 | 0 | 0 | 385 | 53,281 |
| SE Return | 0 | 593 | 822 | 1,050 | 520 | 0 | 0 | 0 | 222 | 0 |
| Harvest | 36 | 325 | 681 | 13,026 | 320 | 0 | 0 | 0 | 0 | 14,388 |
| SE Harvest | 36 | 107 | 152 | 209 | 106 | 0 | 0 | 0 | 0 | 637 |
| H&R[a] Mortality | 0 | 28 | 51 | 244 | 17 | 0 | 0 | 0 | 4 | 344 |
| SE H&R | 0 | 14 | 25 | 114 | 9 | 0 | 0 | 0 | 3 | 160 |
| Escapement[b] | 0 | 2,601 | 5,309 | 28,444 | 1,850 | 0 | 0 | 0 | 381 | 38,549 |
| SE Escapement | 0 | 603 | 836 | 1,077 | 531 | 0 | 0 | 0 | 222 | 657 |
| 1995 | | | | | | | | | | |
| Inriver Return | 0 | 9,900 | 9,470 | 22,383 | 2,367 | 0 | 0 | 0 | 215 | 44,336 |
| SE Return | 0 | 1,290 | 1,269 | 1,548 | 696 | 0 | 0 | 0 | 215 | 0 |
| Harvest | 65 | 704 | 991 | 7,279 | 1,086 | 0 | 0 | 0 | 0 | 10,125 |
| SE Harvest | 38 | 124 | 153 | 424 | 162 | 0 | 0 | 0 | 0 | 511 |
| H&R[a] Mortality | 0 | 70 | 67 | 158 | 17 | 0 | 0 | 0 | 0 | 312 |
| SE H&R | 0 | 33 | 31 | 72 | 9 | 0 | 0 | 0 | 0 | 142 |
| Escapement[b] | 0 | 9,126 | 8,412 | 14,946 | 1,264 | 0 | 0 | 0 | 215 | 33,899 |
| SE Escapement | 0 | 1,296 | 1,279 | 1,607 | 715 | 0 | 0 | 0 | 215 | 530 |
| 1996 | | | | | | | | | | |
| Inriver Return | 115 | 4,140 | 18,285 | 30,934 | 460 | 0 | 0 | 0 | 0 | 53,934 |
| SE Return | 115 | 668 | 1,233 | 1,373 | 229 | 0 | 0 | 0 | 0 | 1,059 |
| Harvest | 25 | 348 | 2,138 | 3,206 | 99 | 0 | 0 | 0 | 0 | 5,816 |
| SE Harvest | 25 | 93 | 230 | 282 | 50 | 0 | 0 | 0 | 0 | 379 |
| H&R[a] Mortality | 0 | 5 | 22 | 37 | 1 | 0 | 0 | 0 | 0 | 64 |
| SE H&R | 0 | 4 | 17 | 29 | 0 | 0 | 0 | 0 | 0 | 50 |
| Escapement[b] | 90 | 3,787 | 16,125 | 27,691 | 360 | 0 | 0 | 0 | 0 | 48,054 |
| SE Escapement | 118 | 674 | 1,254 | 1,402 | 234 | 0 | 0 | 0 | 0 | 1,126 |

[a] Hook and Release.

[b] For some age classes in some years the estimates of the number harvested in the sport fishery is greater than the estimate of the number in the inriver return. The spawning escapement for the age class was set to zero. When this occurred, the total spawning escapement (calculated by subtracting the total sport harvest plus hook-and-release mortality from the inriver return) is not the sum of the escapement across age classes.

**Table 12.-Age components of total returns of Kenai River late-run chinook salmon, 1986-1996.**

| Year | (0.2, 1.1) Age 3 | (0.3, 1.2, 2.1) Age 4 | (0.4, 1.3, 2.2) Age 5 | (0.5, 1.4, 2.3) Age 6 | (1.5, 2.4) Age 7 | (1.6, 2.5) Age 8 | Total Return |
|---|---|---|---|---|---|---|---|
| 1986 | 303 | 12,103 | 35,379 | 29,213 | 2,817 | 22 | 79,837 |
| 1987 | 361 | 3,686 | 22,471 | 46,909 | 833 | 99 | 74,359 |
| 1988 | 454 | 2,235 | 4,197 | 51,249 | 10,221 | | 68,356 |
| 1989 | 108 | 5,053 | 6,228 | 24,908 | 4,901 | 76 | 41,274 |
| 1990 | 65 | 5,805 | 6,606 | 25,260 | 1,920 | | 39,656 |
| 1991 | 61 | 4,306 | 7,718 | 26,993 | 2,411 | | 41,489 |
| 1992 | 347 | 4,311 | 8,828 | 29,638 | 1,249 | | 44,373 |
| 1993 | 528 | 6,367 | 10,789 | 46,594 | 3,649 | | 67,927 |
| 1994 | 625 | 5,218 | 8,802 | 53,740 | 3,937 | 10 | 72,332 |
| 1995 | 398 | 13,357 | 14,351 | 27,980 | 3,522 | 7 | 59,615 |
| 1996 | 490 | 6,040 | 22,650 | 36,411 | 688 | 7 | 66,286 |

**Table 13.-Summary of returns from each brood year, late-run Kenai River chinook salmon, 1978-1996.**

| Year | Spawning Escapement | Return (0.2,1.1) Age 3 | (0.3,1.2,2.1) Age 4 | (0.4,1.3,2.2) Age 5 | (0.5,1.4,2.3) Age 6 | (1.5,2.4) Age 7 | (1.6,2.5) Age 8 | Total Return To Date | Return Per Spawner |
|---|---|---|---|---|---|---|---|---|---|
| 1978 | Unknown | | | | | | (1986) 22 | 22 | |
| 1979 | Unknown | | | | | (1986) 2,817 | (1987) 99 | 2,916 | |
| 1980 | Unknown | | | | (1986) 29,213 | (1987) 833 | | 30,046 | |
| 1981 | Unknown | | | (1986) 35,379 | (1987) 46,909 | (1988) 10,222 | (1989) 76 | 92,586 | |
| 1982 | Unknown | | (1986) 12,103 | (1987) 22,471 | (1988) 51,248 | (1989) 4,901 | | 90,723 | |
| 1983 | Unknown | (1986) 303 | (1987) 3,686 | (1988) 4,197 | (1989) 24,908 | (1990) 1,920 | | 35,014 | |
| 1984 | 31,796 | (1987) 361 | (1988) 2,235 | (1989) 6,228 | (1990) 25,260 | (1991) 2,411 | | 36,495 | 1.15 |
| 1985 | 21,708 | (1988) 454 | (1989) 5,053 | (1990) 6,606 | (1991) 26,993 | (1992) 1,249 | | 40,355 | 1.86 |
| 1986 | 48,037 | (1989) 108 | (1990) 5,805 | (1991) 7,718 | (1992) 29,638 | (1993) 3,649 | (1994) 10 | 46,928 | 0.98 |
| 1987 | 35,518 | (1990) 65 | (1991) 4,306 | (1992) 8,828 | (1993) 46,594 | (1994) 3,937 | (1995) 7 | 63,737 | 1.79 |
| 1988 | 34,024 | (1991) 61 | (1992) 4,311 | (1993) 10,789 | (1994) 53,740 | (1995) 3,522 | (1996) 7 | 72,430 | 2.13 |
| 1989 | 19,581 | (1992) 347 | (1993) 6,367 | (1994) 8,802 | (1995) 27,980 | (1996) 688 | | 44,184 | 2.26 |
| 1990 | 27,086 | (1993) 528 | (1994) 5,218 | (1995) 14,351 | (1996) 36,411 | | | 56,508 | 2.09 |
| 1991 | 27,662 | (1994) 625 | (1995) 13,357 | (1996) 22,650 | | | | 36,632 | 1.32 |
| 1992 | 23,326 | (1995) 398 | (1996) 6,040 | | | | | 6,438 | 0.28 |
| 1993 | 34,032 | (1996) 490 | | | | | | 490 | 0.01 |
| 1994 | 38,549 | | | | | | | 0 | 0.00 |
| 1995 | 33,899 | | | | | | | 0 | 0.00 |
| 1996 | 48,054 | | | | | | | 0 | 0.00 |

**Table 14.-Sibling return ratios for late-run Kenai River chinook salmon from brood years 1980-1992.**

| Brood Year | Age 4/ Age 3 | Age 5/ Age 4 | Age 6/ Age 5 | Age 6/ Age 4+5 | Age 7/ Age 6 | Age 7/ Age 5+6 | Age 7/ Age 4+5+6 |
|---|---|---|---|---|---|---|---|
| 1980 | | | | | 0.03 | | |
| 1981 | | | 1.33 | | 0.22 | 0.12 | |
| 1982 | | 1.86 | 2.28 | 1.48 | 0.10 | 0.07 | 0.06 |
| 1983 | 12.17 | 1.14 | 5.93 | 3.16 | 0.08 | 0.07 | 0.06 |
| 1984 | 6.19 | 2.79 | 4.06 | 2.98 | 0.10 | 0.08 | 0.07 |
| 1985 | 11.13 | 1.31 | 4.09 | 2.32 | 0.05 | 0.04 | 0.03 |
| 1986 | 53.75 | 1.33 | 3.84 | 2.19 | 0.12 | 0.10 | 0.08 |
| 1987 | 66.25 | 2.05 | 5.28 | 3.55 | 0.08 | 0.07 | 0.07 |
| 1988 | 70.67 | 2.50 | 4.98 | 3.56 | 0.07 | 0.06 | 0.05 |
| 1989 | 18.35 | 1.38 | 3.18 | 1.85 | 0.03 | 0.02 | 0.02 |
| 1990 | 9.88 | 2.75 | 2.54 | 1.86 | | | |
| 1991 | 21.37 | 1.70 | | | | | |
| 1992 | 15.18 | | | | | | |
| Mean | 28.49 | 1.88 | 3.75 | 2.55 | 0.09 | 0.07 | 0.05 |
| SD | 24.91 | 0.62 | 1.44 | 0.78 | 0.05 | 0.03 | 0.02 |
| % Co Var | 87 | 33 | 38 | 31 | 63 | 44 | 38 |
| Maximum | 70.67 | 2.79 | 5.93 | 3.56 | 0.22 | 0.12 | 0.08 |
| Minimum | 6.19 | 1.14 | 1.33 | 1.48 | 0.03 | 0.02 | 0.02 |

[a] % Coefficient of variation.

**Table 15.-Summary of expected returns based on sibling return ratios versus observed returns for late-run Kenai River chinook salmon, 1990-1996, and 1997 projections.**

| | Return | | | | | | |
|---|---|---|---|---|---|---|---|
| | Age 3 | Age 4 | Age 5 | Age 6 | Age 7 | Total | |
| 1990 | | | | | | | |
| Expected | 306 | 1,061 | 9,736 | 19,639 | 2,775 | 33,517 | |
| Observed | 65 | 5,806 | 6,606 | 25,259 | 1,920 | 39,656 | |
| Difference | (241) | 4,745 | (3,130) | 5,620 | (855) | 6,139 | |
| Obs. as % of Exp. | 21.2 | 547.2 | 67.9 | 128.6 | 69.2 | 118.3 | |
| 1991 | | | | | | | |
| Expected | 258 | 1,353 | 10,289 | 29,637 | 1,950 | 43,487 | |
| Observed | 61 | 4,306 | 7,718 | 26,993 | 2,411 | 41,489 | |
| Difference | (197) | 2,953 | (2,571) | (2,644) | 461 | (1,998) | |
| Obs. as % of Exp. | 23.6 | 318.3 | 75.0 | 91.1 | 123.6 | 95.4 | |
| 1992 | | | | | | | |
| Expected | 223 | 1,328 | 6,634 | 32,397 | 2,367 | 42,949 | |
| Observed | 347 | 4,311 | 8,828 | 29,638 | 1,249 | 44,373 | |
| Difference | 124 | 2,983 | 2,194 | (2,759) | (1,118) | 1,424 | |
| Obs. as % of Exp. | 155.6 | 324.6 | 133.1 | 91.5 | 52.8 | 103.3 | |
| 1993 | | | | | | | |
| Projected | 234 | 10,327 | 6,808 | 30,048 | 2,279 | 49,696 | |
| Observed | 528 | 6,367 | 10,789 | 46,594 | 3,649 | 67,927 | |
| Difference | 294 | (3,960) | 3,981 | 16,546 | 1,370 | 18,231 | |
| Obs. as % of Exp. | 225.6 | 61.7 | 158.5 | 155.1 | 160.1 | 136.7 | |
| 1994 | | | | | | | |
| Projected | 267 | 14,916 | 10,894 | 37,331 | 3,468 | 66,876 | |
| Observed | 625 | 5,218 | 8,802 | 53,740 | 3,937 | 72,332 | [a] |
| Difference | 358 | (9,698) | (2,092) | 16,409 | 469 | 5,456 | |
| Obs. as % of Exp. | 234.1 | 35.0 | 80.8 | 144.0 | 113.5 | 108.2 | |
| 1995 | | | | | | | |
| Projected | 316 | 19,276 | 9,301 | 41,502 | 4,220 | 74,615 | |
| Observed | 398 | 13,357 | 14,351 | 27,980 | 3,522 | 59,615 | [b] |
| Difference | 82 | (5,919) | 5,050 | (13,522) | (698) | (15,000) | |
| Obs. as % of Exp. | 125.9 | 69.3 | 154.3 | 67.4 | 83.5 | 79.9 | |
| 1996 | | | | | | | |
| Projected | 325 | 11,929 | 25,385 | 51,576 | 2,596 | 91,811 | |
| Observed | 490 | 6,040 | 22,650 | 36,411 | 688 | 66,286 | [c] |
| Difference | 165 | (5,889) | (2,735) | (15,165) | (1,908) | (25,525) | |
| Obs. as % of Exp. | 150.8 | 50.6 | 89.2 | 70.6 | 26.5 | 72.2 | |
| 1997 | | | | | | | |
| Projected | 340 | 13,962 | 11,355 | 91,799 | 3,058 | 120,514 | |
| Standard Error | 191 | 14,314 | 4,339 | 29,146 | 1,356 | 32,788 | |

[a] Includes 10 age-8 fish.

[b] Includes seven age-8 fish.

[c] Includes seven age-8 fish.

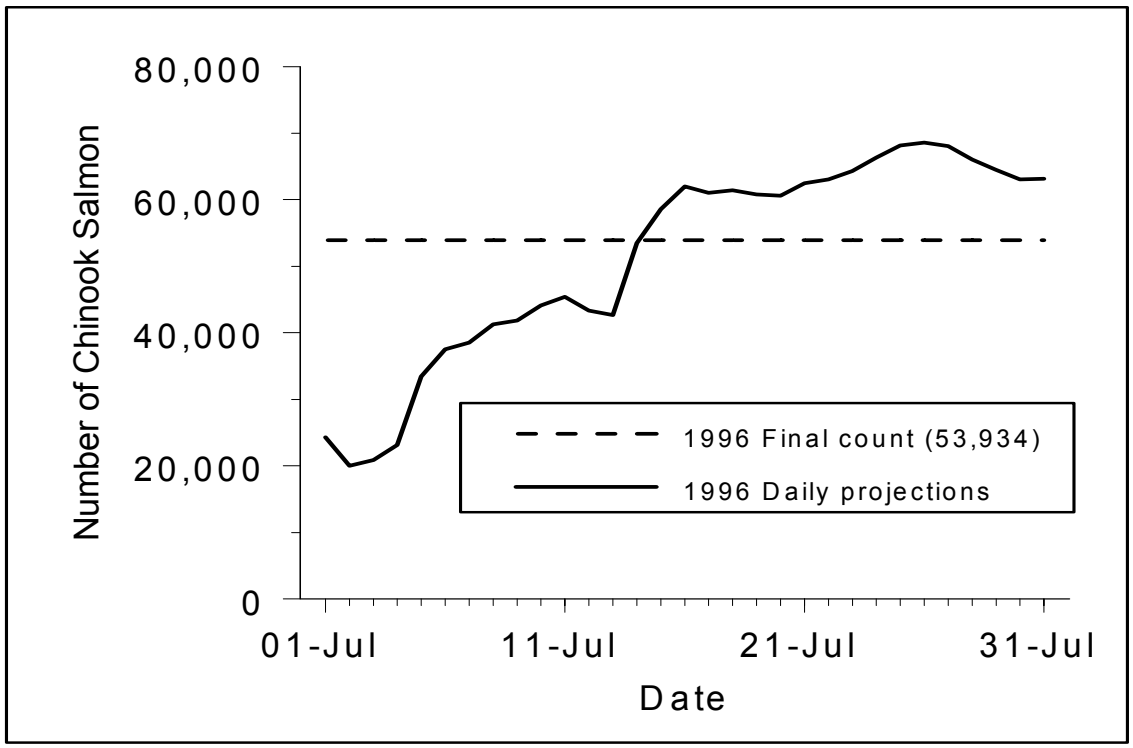


**Figure 4.-Daily projections of total inriver return vs. the actual inriver return of late-run chinook salmon, Kenai River, 1996.**

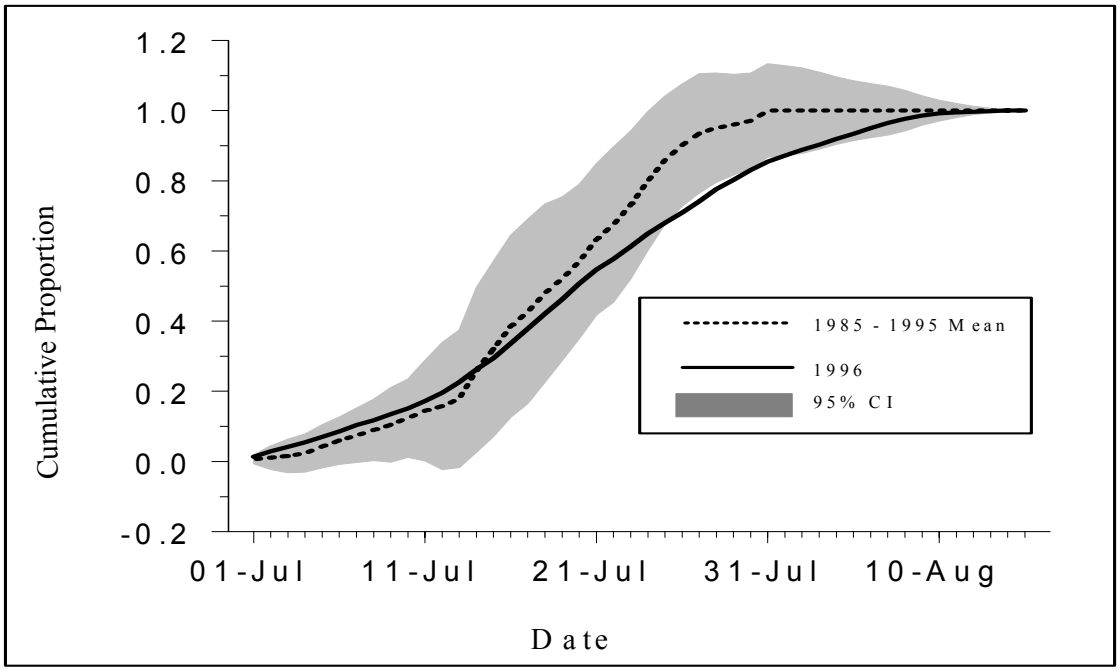


**Figure 5.-Cumulative proportions by date for the inriver return of late-run chinook salmon to the Kenai River, 1985-1995 mean vs. 1996.**

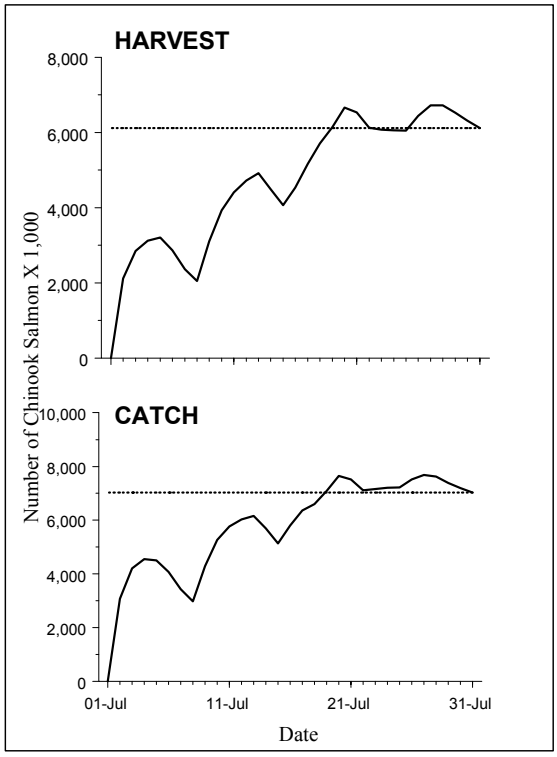


**Figure 6.-Daily projections of seasonal (1 July-31 July) harvest and catch (solid lines) vs. realized harvest and catch (dotted lines) of late-run chinook salmon by the recreational fishery, Kenai River, 1996.**

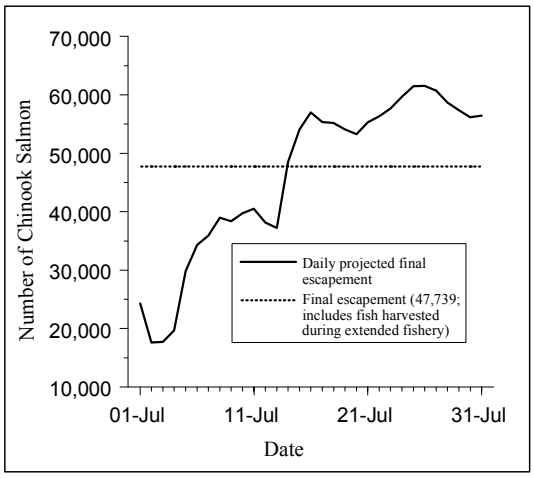


**Figure 7.-Daily projections of final escapement of chinook salmon during the recreational fishery for late-run chinook salmon, Kenai River, 1996.**

# DISCUSSION

Timely estimates of harvest and inriver return allow for the precise management specified in the management plan. The ability to obtain real-time estimates of inriver return provides the basis for the department to react to changing situations on relatively short notice. During 1996, the fishery was liberalized by adding 4 days in August based on projections of exceeding the desired escapement goals set out in the management plan.

Analysis of four run timing models to predict the inriver return was completed in 1993 (Hammarstrom 1994a) and the mean timing model was selected as the model of choice. This model performed reasonably well again in 1996 and should be used in 1997.

Results of the sibling model to predict future returns have been encouraging. Projected returns for 1990-1996 ranged from 33,517 to 91,811 chinook salmon and realized returns ranged from 39,656 to 72,332 chinook salmon. Forecasts have been less than observed returns for 4 of the 7 years this model has been used. Observed returns have ranged from 73% to 137% of the expected return with the 1992 forecast being the closest to the realized return (103%). Predictions have been within an average of 3% of the actual returns. Although the fishery is managed based on inseason return, forecasts are beneficial in preparing the fishing public, in a general sense, for the type of fishery to expect. Evaluation of this model should therefore continue, and I recommend that the sibling model be used for 1997.

The escapement objective of 22,300 fish has been exceeded in every year since 1984, except for 1985 and 1989. Omitting those two years, the goal has been exceeded by an average of 12,500 chinook salmon. Restrictions to the recreational fishery were employed in 1990 and again in 1992. The

commercial fishery was restricted in 1992. The recreational fishery was liberalized in 1991, 1993, 1994, 1995 and 1996. The anticipated total return of over 120,000 chinook salmon in 1997 would allow for a harvest of nearly 100,000 fish by all fisheries. Over 75% (91,799 fish) of the forecast is age-6 fish from the 1991 brood, which is 70% higher than any observed return of age-6 fish (Table 13). Should the forecast be realized and normal timing occur, some liberalization to the recreational fishery is probable and no inseason restrictions to the commercial fishery based on conservation concerns for chinook salmon should be required.

Over the past 3 years, the department has been examining some of the assumptions necessary to incorporate hydroacoustic enumeration of chinook salmon into the Kenai River. Testing of two critical assumptions, that target strength is definitive in separating larger chinook salmon from smaller more abundant sockeye salmon, and that spatial separation of the two species provides reasonable distinction between the species, has not been conclusive. These problems may be more pronounced at times of relatively high sockeye salmon abundance which is more of a concern during the late run. Additional testing and a program to further define late-run inriver exploitation was accomplished in 1996.

Results from a telemetry study to estimate exploitation rate in the recreational fishery are preliminary at this time There seems to be relative agreement between inriver return estimated as a function of harvest and exploitation with that of the sonar counter and the creel survey to estimate exploitation rate. This telemetry study will be repeated again in 1997.

Implementation of the current management plan relies on the ability to assess the magnitude of the chinook salmon return inseason. Evaluation of escapement goals and production requires accurate determination of run strength. Sonar seems to provide the potential to accomplish both tasks; however, to be successful, the aforementioned concerns need to be resolved.

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# APPENDIX A. KENAI RIVER LATE KING SALMON MANAGEMENT PLAN

**Appendix A1.-Kenai River late king salmon management plan.**

5 AAC 21.359 KENAI RIVER LATE KING SALMON MANAGEMENT PLAN

(a) The purpose of this management plan is to insure an adequate escapement of late run chinook salmon into the Kenai River system and to provide management guidelines to the department.

(b) The department shall manage the late run Kenai River chinook salmon to achieve a minimum spawning escapement level of 15,500 salmon and an optimum spawning escapement level of 22,300 salmon as follows:

(1) if the projected spawning escapement level is less than 15,500, the department shall

(A) close the recreational fisheries in the Kenai River and in the salt waters of Cook Inlet north of the latitude of Bluff Point to the taking of chinook salmon;

(B) close the drift gill net fishery in the Central District within 3 miles of the Kenai Peninsula shoreline; and

(C) close the set gill net fishery in the Upper Subdistrict of the Central District;

(2) if the projected spawning escapement level is between 15,500 and 22,300 chinook salmon, the department shall restrict the taking of chinook salmon in the Kenai River recreational fisheries as necessary to achieve the optimum escapement; the department shall establish periods by emergency order during which

(A) time or area is reduced;

(B) bag or possession limits are zero; when the sport fishery is restricted to catch and release only, king salmon 52 inches or more in length may be retained; or

Note: changed from "(B) bag or possession limits are zero; or" in 1990

(C) only artificial lures may be used.

Note: The following sections modified the original plan above and were adopted at the December 1990 meeting of the Board of Fisheries.

(3) if the projected spawning escapement of chinook salmon is between 15,500 and 19,900, the department shall limit the set gill net fishery in the Upper Subdistrict of the Central District to regular periods;

(c) however, if the final inriver sonar count is projected to exceed 700,000 sockeye salmon, then the drift gill net fishery and the set gill net fishery will not be restricted to conserve Kenai River chinook salmon unless the projected spawning escapement is less than 15,500, consistent with (b)(1).

(d) consistent with the purpose of this management plan, the department shall not reduce closed waters at the mouth of the Kenai River when the projected escapement level is less than 22,300 chinook salmon.

(e) the Kasilof River Sockeye Salmon Special Harvest Area Management Plan (5 AAC 21.356) is exempt from all provisions of this management plan.

Effective 1989, modified 1991, 1996.

# APPENDIX B. STATISTICAL METHODS

**Appendix B1.-Statistical methods for estimating sibling ratios and expected returns.**

Age structure is a conservative trait in salmonids, the age classes represented within brood years in a stock do not change drastically across years. The distribution of numbers returning in each age class within a brood year may also be a stable character within a stock. The relationships between ages within a brood year, or sibling relationships, were used to estimate future returns by brood year.

Sibling ratios, $r_{ab}$, were estimated as the ratio of the return at age a to the total return at one or more younger ages for each brood year b:

$$\hat{r}_{ab} = \frac{\hat{n}_{ab}}{\hat{n}_{a'b}}, \tag{B1.1}$$

where $\hat{n}_{ab}$ is the estimated number of fish from brood year b returning at age a and $\hat{n}_{a'b}$ is the estimated number from brood year b returning at ages 3 through "a - 1":

$$\hat{n}_{a'b} = \sum_{j=4}^{a-1} \hat{n}_{jb}. \tag{B1.2}$$

Age 3 is the first year at which late-run Kenai River chinook salmon return in substantial numbers. Sibling ratios were estimated for ages 4 through 7. The variances of the estimated sibling ratios were estimated as:

$$\hat{V}[\hat{r}_{ab}] = \hat{r}_{ab}^2 \left( \frac{\hat{V}[\hat{n}_{ab}]}{\hat{n}_{ab}^2} + \frac{\hat{V}[\hat{n}_{a'b}]}{\hat{n}_{a'b}^2} \right), \tag{B1.3}$$

where:

$$\hat{V}[\hat{n}_{a'b}] = \sum_{j=4}^{a-1} \hat{V}[\hat{n}_{jb}]. \tag{B1.4}$$

The expected returns of fish aged a = 4, 5, 6, and 7 in the year (Y) to be forecasted are:

$$\tilde{n}_a = \bar{r}_a \hat{n}_{a'b}, \tag{B1.5}$$

where $\bar{r}_a$ is the mean age-a sibling ratio, averaged over all $m_a$ brood years for which the ratio could be estimated:

$$\bar{r}_a = \frac{1}{m_a} \sum_{b=1}^{m_a} \hat{r}_{ab}, \tag{B1.6}$$

and where b = Y - a.

-continued-

The variance of the forecasted returns by age was estimated as:

$$\hat{V}[\tilde{n}_a] = \bar{r}_a^2 \hat{V}[\hat{n}_{a'b}] + \hat{n}_{a'b}^2 \hat{V}'[\bar{r}_a] - \hat{V}'[\bar{r}_a]\hat{V}[\hat{n}_{a'b}], \tag{B1.7}$$

where $\hat{V}'[\bar{r}_a]$ is the squared prediction error of $\bar{r}_a$:

$$\hat{V}'[\bar{r}_a] = \frac{\sum_{b=1}^{m_a}(\hat{r}_{ab} - \bar{r}_a)^2}{m_a - 1} + \frac{\sum_{b=1}^{m_a}\hat{V}[\hat{r}_{ab}]}{m_a}. \tag{B1.8}$$

The expected return of age-3 fish in 1996 was forecast to be the mean of past age-3 returns:

$$\tilde{n}_3 = \frac{\sum_{b=1}^{m_a}\hat{n}_{3b}}{m_a}. \tag{B1.9}$$

The variance of the forecasted return of age 3 fish was estimated as the sample variance:

$$\hat{V}[\tilde{n}_3] = \frac{\sum_{b=1}^{m_a}(\hat{n}_{3b} - \tilde{n}_3)^2}{m_a - 1}. \tag{B1.10}$$

Total return was forecast to be:

$$\tilde{n} = \sum_{a=3}^{7}\tilde{n}_a, \tag{B1.11}$$

with variance:

$$\hat{V}[\tilde{n}] = \sum_{a=3}^{7}\hat{V}[\tilde{n}_a]. \tag{B1.12}$$

**Appendix B2.-Statistical methods for analyzing migratory timing.**

The distribution over time of salmon migrating past any fixed location can be described by a migratory time distribution function (Mundy 1982). We used historical databases of sonar counts, sport fishing effort, harvest per hour, catch per hour, harvest, and catch to predict final estimates of these parameters inseason. Our databases consisted of values, for example counts or harvests of chinook salmon, by day (t). Daily cumulative proportions were calculated for each year (i) of data and for each parameter. Daily values were summed to calculate a total ($N_i$) for the year. For each day t and year i, the cumulative proportion $p_{ti}$ was calculated as:

$$p_{ti} = n_{ti} / N_i \ , \tag{B2.1}$$

where $n_{ti}$ is the cumulative sum to date. For each year i, the set $P_i$ of all cumulative proportions ($p_{1i}$, $p_{2i}$, $p_{3i}$, . . .) represents the annual empirical cumulative distribution function (CDF). The mid-point of the migration, or median of the distribution, is reached when $p_{ti}$ is equal to 0.5.

For any day the mean cumulative proportion ($\bar{p}_{t\cdot}$) over all m years was calculated as:

$$\bar{p}_{t\cdot} = \frac{1}{m}\sum_{i=1}^{m} p_{ti} \ ; \tag{B2.2}$$

with variance:

$$\hat{V}[\bar{p}_{t\cdot}] = \frac{1}{m}\sum_{i=1}^{m}(p_{ti} - \bar{p}_{t\cdot})^2 \ . \tag{B2.3}$$

At any point in a migration, the mean cumulative proportion to date can be used to forecast the total given the number known to have passed to date. Since $n_{tj}$ represents the number passed by day t in year j, then the predicted total for that year is:

$$\tilde{N}_j = \frac{n_{tj}}{\bar{p}_{t\cdot}}, \tag{B2.4}$$

and the variance of $\tilde{N}_j$ by:

$$\hat{V}[\tilde{N}_j] = \tilde{N}_j^2\left[\frac{\hat{V}[n_{tj}]}{n_{tj}^2} + \frac{\hat{V}[\bar{p}_{t\cdot}]}{\bar{p}_{t\cdot}^2}\right]. \tag{B2.5}$$

# APPENDIX C. SUPPORTING STATISTICS

**Appendix C1.-Historical daily cumulative proportions of the inriver return of late-run chinook salmon to the Kenai River, 1985-1996.**

| | Daily cumulative proportions [P(t)] by year of inriver return | | | | | | | | | | | | | 95% Confidence Interval | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | Mean | SE | Low | High | RP[a] | 1996 |
| 7/01 | 0.025 | 0.014 | 0.012 | 0.012 | 0.036 | 0.016 | 0.008 | 0.012 | 0.011 | 0.012 | 0.008 | 0.015 | 0.002 | 0.010 | 0.021 | 36.7% | 0.006 |
| 7/02 | 0.049 | 0.070 | 0.028 | 0.031 | 0.072 | 0.025 | 0.016 | 0.022 | 0.020 | 0.019 | 0.017 | 0.034 | 0.006 | 0.020 | 0.047 | 41.4% | 0.011 |
| 7/03 | 0.080 | 0.095 | 0.040 | 0.063 | 0.088 | 0.038 | 0.026 | 0.032 | 0.026 | 0.031 | 0.025 | 0.049 | 0.008 | 0.031 | 0.068 | 36.6% | 0.016 |
| 7/04 | 0.099 | 0.111 | 0.040 | 0.076 | 0.120 | 0.050 | 0.041 | 0.039 | 0.034 | 0.047 | 0.035 | 0.063 | 0.010 | 0.041 | 0.085 | 34.9% | 0.024 |
| 7/05 | 0.120 | 0.116 | 0.067 | 0.101 | 0.158 | 0.075 | 0.050 | 0.046 | 0.043 | 0.060 | 0.050 | 0.080 | 0.011 | 0.055 | 0.106 | 31.6% | 0.043 |
| 7/06 | 0.138 | 0.122 | 0.086 | 0.117 | 0.198 | 0.096 | 0.057 | 0.057 | 0.061 | 0.080 | 0.066 | 0.098 | 0.013 | 0.069 | 0.127 | 29.7% | 0.060 |
| 7/07 | 0.170 | 0.127 | 0.104 | 0.148 | 0.235 | 0.117 | 0.062 | 0.065 | 0.092 | 0.100 | 0.087 | 0.119 | 0.015 | 0.085 | 0.153 | 28.5% | 0.074 |
| 7/08 | 0.190 | 0.131 | 0.117 | 0.176 | 0.267 | 0.129 | 0.066 | 0.071 | 0.130 | 0.112 | 0.096 | 0.135 | 0.017 | 0.096 | 0.174 | 28.7% | 0.090 |
| 7/09 | 0.206 | 0.142 | 0.127 | 0.210 | 0.326 | 0.139 | 0.077 | 0.078 | 0.167 | 0.126 | 0.108 | 0.155 | 0.022 | 0.107 | 0.203 | 31.0% | 0.105 |
| 7/10 | 0.232 | 0.154 | 0.139 | 0.243 | 0.386 | 0.150 | 0.091 | 0.085 | 0.184 | 0.150 | 0.118 | 0.176 | 0.026 | 0.118 | 0.233 | 32.9% | 0.124 |
| 7/11 | 0.264 | 0.166 | 0.150 | 0.265 | 0.435 | 0.171 | 0.103 | 0.090 | 0.209 | 0.159 | 0.126 | 0.194 | 0.030 | 0.128 | 0.260 | 34.0% | 0.145 |
| 7/12 | 0.292 | 0.181 | 0.163 | 0.301 | 0.498 | 0.188 | 0.112 | 0.124 | 0.222 | 0.175 | 0.132 | 0.217 | 0.034 | 0.142 | 0.292 | 34.7% | 0.158 |
| 7/13 | 0.325 | 0.219 | 0.185 | 0.337 | 0.531 | 0.223 | 0.121 | 0.144 | 0.290 | 0.195 | 0.145 | 0.247 | 0.036 | 0.167 | 0.327 | 32.4% | 0.179 |
| 7/14 | 0.376 | 0.250 | 0.204 | 0.362 | 0.603 | 0.267 | 0.138 | 0.166 | 0.354 | 0.220 | 0.161 | 0.282 | 0.041 | 0.191 | 0.373 | 32.3% | 0.261 |
| 7/15 | 0.414 | 0.283 | 0.220 | 0.395 | 0.631 | 0.301 | 0.153 | 0.191 | 0.399 | 0.261 | 0.178 | 0.312 | 0.042 | 0.217 | 0.406 | 30.2% | 0.321 |
| 7/16 | 0.458 | 0.333 | 0.249 | 0.446 | 0.662 | 0.332 | 0.183 | 0.214 | 0.445 | 0.333 | 0.222 | 0.353 | 0.043 | 0.257 | 0.448 | 27.0% | 0.386 |
| 7/17 | 0.485 | 0.377 | 0.298 | 0.474 | 0.694 | 0.405 | 0.241 | 0.233 | 0.486 | 0.421 | 0.247 | 0.396 | 0.042 | 0.303 | 0.490 | 23.6% | 0.427 |
| 7/18 | 0.495 | 0.397 | 0.328 | 0.498 | 0.727 | 0.469 | 0.331 | 0.261 | 0.515 | 0.462 | 0.336 | 0.438 | 0.039 | 0.352 | 0.524 | 19.7% | 0.480 |
| 7/19 | 0.510 | 0.421 | 0.355 | 0.534 | 0.743 | 0.510 | 0.390 | 0.298 | 0.530 | 0.527 | 0.442 | 0.478 | 0.036 | 0.399 | 0.558 | 16.6% | 0.521 |
| 7/20 | 0.523 | 0.441 | 0.386 | 0.555 | 0.766 | 0.556 | 0.433 | 0.336 | 0.557 | 0.571 | 0.550 | 0.516 | 0.035 | 0.438 | 0.593 | 15.0% | 0.570 |
| 7/21 | 0.565 | 0.466 | 0.429 | 0.583 | 0.793 | 0.580 | 0.464 | 0.362 | 0.577 | 0.603 | 0.621 | 0.549 | 0.035 | 0.472 | 0.627 | 14.2% | 0.633 |
| 7/22 | 0.596 | 0.490 | 0.469 | 0.620 | 0.811 | 0.596 | 0.494 | 0.383 | 0.600 | 0.629 | 0.699 | 0.581 | 0.036 | 0.501 | 0.660 | 13.7% | 0.675 |
| 7/23 | 0.627 | 0.527 | 0.499 | 0.649 | 0.835 | 0.616 | 0.571 | 0.431 | 0.624 | 0.648 | 0.753 | 0.616 | 0.034 | 0.541 | 0.692 | 12.3% | 0.732 |
| 7/24 | 0.656 | 0.589 | 0.533 | 0.673 | 0.847 | 0.650 | 0.635 | 0.454 | 0.651 | 0.672 | 0.772 | 0.648 | 0.032 | 0.578 | 0.719 | 10.9% | 0.799 |
| 7/25 | 0.692 | 0.603 | 0.578 | 0.696 | 0.864 | 0.675 | 0.672 | 0.511 | 0.696 | 0.698 | 0.791 | 0.680 | 0.029 | 0.615 | 0.744 | 9.5% | 0.859 |
| 7/26 | 0.723 | 0.629 | 0.616 | 0.717 | 0.883 | 0.695 | 0.708 | 0.553 | 0.724 | 0.724 | 0.829 | 0.709 | 0.028 | 0.647 | 0.771 | 8.7% | 0.902 |
| 7/27 | 0.767 | 0.654 | 0.648 | 0.739 | 0.899 | 0.718 | 0.742 | 0.605 | 0.764 | 0.747 | 0.870 | 0.741 | 0.027 | 0.682 | 0.801 | 8.0% | 0.935 |
| 7/28 | 0.808 | 0.678 | 0.686 | 0.756 | 0.911 | 0.737 | 0.797 | 0.669 | 0.802 | 0.788 | 0.888 | 0.775 | 0.024 | 0.721 | 0.828 | 6.9% | 0.951 |
| 7/29 | 0.825 | 0.700 | 0.711 | 0.769 | 0.924 | 0.754 | 0.830 | 0.720 | 0.830 | 0.813 | 0.900 | 0.798 | 0.022 | 0.748 | 0.848 | 6.3% | 0.960 |
| 7/30 | 0.865 | 0.728 | 0.751 | 0.783 | 0.937 | 0.766 | 0.852 | 0.759 | 0.862 | 0.846 | 0.912 | 0.824 | 0.021 | 0.777 | 0.871 | 5.7% | 0.971 |
| 7/31 | 0.885 | 0.754 | 0.801 | 0.814 | 0.948 | 0.776 | 0.880 | 0.791 | 0.880 | 0.880 | 0.922 | 0.848 | 0.019 | 0.806 | 0.891 | 5.0% | 1.000 |

-continued-

## Appendix C1.-Page 2 of 2.

| Date | Daily cumulative proportions [P(t)] by year of inriver return | | | | | | | | | | | Mean | SE | 95% Confidence Interval | | RP[a] | 1996 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | | | Low | High | | |
| 8/01 | 0.909 | 0.778 | 0.841 | 0.850 | 0.966 | 0.788 | 0.906 | 0.821 | 0.895 | 0.900 | 0.933 | 0.871 | 0.018 | 0.831 | 0.912 | 4.6% | 1.000 |
| 8/02 | 0.920 | 0.799 | 0.841 | 0.887 | 0.973 | 0.800 | 0.930 | 0.855 | 0.908 | 0.923 | 0.941 | 0.889 | 0.017 | 0.850 | 0.928 | 4.4% | 1.000 |
| 8/03 | 0.929 | 0.829 | 0.864 | 0.917 | 0.977 | 0.816 | 0.941 | 0.882 | 0.914 | 0.943 | 0.952 | 0.906 | 0.016 | 0.871 | 0.941 | 3.8% | 1.000 |
| 8/04 | 0.939 | 0.855 | 0.891 | 0.941 | 0.986 | 0.838 | 0.950 | 0.911 | 0.924 | 0.955 | 0.963 | 0.923 | 0.014 | 0.892 | 0.954 | 3.3% | 1.000 |
| 8/05 | 0.952 | 0.874 | 0.913 | 0.968 | 0.986 | 0.860 | 0.955 | 0.939 | 0.938 | 0.965 | 0.972 | 0.938 | 0.012 | 0.911 | 0.966 | 2.9% | 1.000 |
| 8/06 | 0.962 | 0.895 | 0.924 | 0.987 | 0.986 | 0.877 | 0.965 | 0.961 | 0.960 | 0.985 | 0.982 | 0.953 | 0.011 | 0.928 | 0.978 | 2.7% | 1.000 |
| 8/07 | 0.984 | 0.917 | 0.945 | 1.000 | 1.000 | 0.893 | 0.983 | 0.979 | 0.973 | 1.000 | 0.988 | 0.969 | 0.011 | 0.945 | 0.993 | 2.5% | 1.000 |
| 8/08 | 0.997 | 0.935 | 0.965 | 1.000 | 1.000 | 0.915 | 1.000 | 0.986 | 0.986 | 1.000 | 0.994 | 0.980 | 0.009 | 0.960 | 1.000 | 2.0% | 1.000 |
| 8/09 | 1.000 | 0.956 | 0.977 | 1.000 | 1.000 | 0.936 | 1.000 | 0.992 | 0.995 | 1.000 | 1.000 | 0.987 | 0.007 | 0.972 | 1.002 | 1.5% | 1.000 |
| 8/10 | 1.000 | 0.968 | 0.989 | 1.000 | 1.000 | 0.957 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 0.992 | 0.005 | 0.982 | 1.002 | 1.0% | 1.000 |
| 8/11 | 1.000 | 0.975 | 1.000 | 1.000 | 1.000 | 0.974 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 0.995 | 0.003 | 0.988 | 1.002 | 0.7% | 1.000 |
| 8/12 | 1.000 | 0.984 | 1.000 | 1.000 | 1.000 | 0.985 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 0.997 | 0.002 | 0.993 | 1.001 | 0.4% | 1.000 |
| 8/13 | 1.000 | 0.992 | 1.000 | 1.000 | 1.000 | 0.992 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 0.999 | 0.001 | 0.996 | 1.001 | 0.2% | 1.000 |
| 8/14 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 0.996 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 0.000 | 0.999 | 1.000 | 0.1% | 1.000 |
| 8/15 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 0.000 | 1.000 | 1.000 | 0.0% | 1.000 |

[a] Relative precision of the 95% confidence interval.

**Appendix C2.-Historical daily cumulative proportions of the effort by unguided anglers during the return of late-run chinook salmon to the Kenai River, 1984-1996.**

| | Daily cumulative proportions [P(t)] by year of unguided angler effort | | | | | | | | | | | | | | | 95% Confidence Interval | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Mean | SE | Low | High | RP[a] |
| 7/01 | 0.009 | 0.005 | 0.015 | 0.004 | 0.018 | 0.032 | 0.051 | 0.000 | 0.030 | 0.012 | 0.014 | 0.029 | 0.000 | 0.017 | 0.004 | 0.008 | 0.026 | 54.0% |
| 7/02 | 0.022 | 0.011 | 0.026 | 0.016 | 0.044 | 0.070 | 0.051 | 0.022 | 0.052 | 0.027 | 0.036 | 0.073 | 0.017 | 0.036 | 0.006 | 0.024 | 0.049 | 34.4% |
| 7/03 | 0.040 | 0.013 | 0.046 | 0.053 | 0.069 | 0.070 | 0.091 | 0.036 | 0.087 | 0.056 | 0.064 | 0.073 | 0.027 | 0.056 | 0.006 | 0.042 | 0.070 | 24.8% |
| 7/04 | 0.063 | 0.024 | 0.069 | 0.090 | 0.069 | 0.101 | 0.109 | 0.059 | 0.127 | 0.090 | 0.064 | 0.108 | 0.040 | 0.078 | 0.008 | 0.060 | 0.096 | 22.7% |
| 7/05 | 0.092 | 0.046 | 0.112 | 0.142 | 0.089 | 0.129 | 0.138 | 0.084 | 0.155 | 0.090 | 0.082 | 0.125 | 0.053 | 0.103 | 0.009 | 0.082 | 0.123 | 19.9% |
| 7/06 | 0.108 | 0.084 | 0.124 | 0.142 | 0.102 | 0.151 | 0.169 | 0.118 | 0.155 | 0.112 | 0.099 | 0.147 | 0.073 | 0.122 | 0.008 | 0.104 | 0.140 | 14.5% |
| 7/07 | 0.163 | 0.102 | 0.124 | 0.162 | 0.123 | 0.181 | 0.209 | 0.141 | 0.170 | 0.134 | 0.125 | 0.158 | 0.097 | 0.145 | 0.009 | 0.126 | 0.165 | 13.4% |
| 7/08 | 0.214 | 0.102 | 0.151 | 0.184 | 0.147 | 0.228 | 0.242 | 0.141 | 0.196 | 0.166 | 0.148 | 0.189 | 0.097 | 0.170 | 0.012 | 0.143 | 0.197 | 15.9% |
| 7/09 | 0.214 | 0.121 | 0.169 | 0.211 | 0.204 | 0.280 | 0.242 | 0.164 | 0.219 | 0.188 | 0.160 | 0.220 | 0.120 | 0.193 | 0.013 | 0.165 | 0.221 | 14.4% |
| 7/10 | 0.237 | 0.148 | 0.188 | 0.250 | 0.252 | 0.280 | 0.269 | 0.188 | 0.246 | 0.240 | 0.175 | 0.220 | 0.142 | 0.218 | 0.013 | 0.191 | 0.245 | 12.6% |
| 7/11 | 0.260 | 0.180 | 0.209 | 0.299 | 0.252 | 0.323 | 0.297 | 0.215 | 0.282 | 0.311 | 0.175 | 0.254 | 0.166 | 0.248 | 0.015 | 0.215 | 0.281 | 13.2% |
| 7/12 | 0.280 | 0.206 | 0.248 | 0.336 | 0.285 | 0.357 | 0.331 | 0.243 | 0.326 | 0.311 | 0.215 | 0.281 | 0.191 | 0.278 | 0.015 | 0.245 | 0.310 | 11.7% |
| 7/13 | 0.306 | 0.278 | 0.298 | 0.336 | 0.314 | 0.394 | 0.361 | 0.300 | 0.326 | 0.348 | 0.245 | 0.305 | 0.224 | 0.311 | 0.013 | 0.283 | 0.338 | 8.9% |
| 7/14 | 0.367 | 0.354 | 0.298 | 0.387 | 0.352 | 0.425 | 0.422 | 0.366 | 0.383 | 0.382 | 0.278 | 0.338 | 0.283 | 0.356 | 0.013 | 0.328 | 0.385 | 8.0% |
| 7/15 | 0.431 | 0.354 | 0.350 | 0.418 | 0.384 | 0.484 | 0.490 | 0.366 | 0.427 | 0.425 | 0.310 | 0.397 | 0.283 | 0.394 | 0.017 | 0.357 | 0.431 | 9.4% |
| 7/16 | 0.431 | 0.413 | 0.376 | 0.450 | 0.445 | 0.530 | 0.490 | 0.403 | 0.466 | 0.465 | 0.355 | 0.459 | 0.331 | 0.432 | 0.015 | 0.398 | 0.465 | 7.8% |
| 7/17 | 0.462 | 0.477 | 0.426 | 0.491 | 0.491 | 0.530 | 0.542 | 0.451 | 0.504 | 0.518 | 0.420 | 0.459 | 0.366 | 0.472 | 0.014 | 0.442 | 0.502 | 6.3% |
| 7/18 | 0.506 | 0.503 | 0.470 | 0.547 | 0.491 | 0.583 | 0.590 | 0.483 | 0.576 | 0.572 | 0.420 | 0.504 | 0.403 | 0.511 | 0.017 | 0.475 | 0.548 | 7.1% |
| 7/19 | 0.556 | 0.525 | 0.525 | 0.595 | 0.583 | 0.618 | 0.645 | 0.532 | 0.674 | 0.572 | 0.479 | 0.549 | 0.450 | 0.562 | 0.017 | 0.524 | 0.600 | 6.8% |

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## Appendix C2.-Page 2 of 2.

| | Daily cumulative proportions [P(t)] by year of unguided angler effort | | | | | | | | | | | | | | | 95% Confidence Interval | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Mean | SE | Low | High | RP[a] |
| 7/20 | 0.594 | 0.556 | 0.590 | 0.595 | 0.620 | 0.638 | 0.679 | 0.581 | 0.674 | 0.622 | 0.522 | 0.601 | 0.520 | 0.600 | 0.014 | 0.570 | 0.629 | 4.9% |
| 7/21 | 0.649 | 0.575 | 0.590 | 0.633 | 0.659 | 0.678 | 0.766 | 0.641 | 0.714 | 0.672 | 0.564 | 0.638 | 0.607 | 0.645 | 0.016 | 0.611 | 0.679 | 5.2% |
| 7/22 | 0.705 | 0.575 | 0.615 | 0.654 | 0.689 | 0.727 | 0.836 | 0.641 | 0.762 | 0.723 | 0.602 | 0.720 | 0.607 | 0.681 | 0.021 | 0.636 | 0.726 | 6.6% |
| 7/23 | 0.705 | 0.616 | 0.649 | 0.686 | 0.741 | 0.761 | 0.836 | 0.682 | 0.827 | 0.753 | 0.671 | 0.788 | 0.666 | 0.722 | 0.019 | 0.680 | 0.763 | 5.8% |
| 7/24 | 0.741 | 0.663 | 0.696 | 0.727 | 0.785 | 0.761 | 0.881 | 0.722 | 0.840 | 0.789 | 0.721 | 0.788 | 0.705 | 0.755 | 0.017 | 0.719 | 0.792 | 4.8% |
| 7/25 | 0.778 | 0.717 | 0.746 | 0.790 | 0.785 | 0.807 | 0.930 | 0.759 | 0.855 | 0.825 | 0.756 | 0.826 | 0.750 | 0.794 | 0.016 | 0.760 | 0.828 | 4.3% |
| 7/26 | 0.801 | 0.761 | 0.812 | 0.840 | 0.827 | 0.838 | 0.975 | 0.804 | 0.873 | 0.825 | 0.789 | 0.874 | 0.805 | 0.833 | 0.015 | 0.800 | 0.865 | 3.9% |
| 7/27 | 0.842 | 0.845 | 0.874 | 0.840 | 0.858 | 0.875 | 0.986 | 0.852 | 0.873 | 0.860 | 0.830 | 0.909 | 0.860 | 0.869 | 0.011 | 0.845 | 0.894 | 2.8% |
| 7/28 | 0.894 | 0.903 | 0.874 | 0.884 | 0.892 | 0.915 | 0.992 | 0.967 | 0.891 | 0.894 | 0.874 | 0.948 | 0.925 | 0.912 | 0.010 | 0.890 | 0.934 | 2.4% |
| 7/29 | 0.957 | 0.903 | 0.923 | 0.920 | 0.929 | 0.960 | 0.996 | 0.967 | 0.902 | 0.934 | 0.912 | 0.963 | 0.925 | 0.938 | 0.008 | 0.921 | 0.955 | 1.8% |
| 7/30 | 0.957 | 0.962 | 0.959 | 0.959 | 0.967 | 1.000 | 0.996 | 0.990 | 0.957 | 0.967 | 0.953 | 0.995 | 0.982 | 0.973 | 0.005 | 0.962 | 0.983 | 1.1% |
| 7/31 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 0.000 | 1.000 | 1.000 | 0.0% |

[a] Relative precision of the 95% confidence interval.

**Appendix C3.-Historical daily cumulative proportions of the harvest of chinook salmon by unguided anglers during the return of late-run chinook salmon to the Kenai River, 1984-1996.**

| | Daily cumulative proportions [P(t)] by year of harvest by unguided anglers | | | | | | | | | | | | | | | 95% Confidence Interval | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Mean | SE | Low | High | RP[a] |
| 7/01 | 0.002 | 0.002 | 0.017 | 0.002 | 0.028 | 0.022 | 0.071 | 0.000 | 0.015 | 0.019 | 0.002 | 0.009 | 0.000 | 0.016 | 0.006 | 0.003 | 0.030 | 83.3% |
| 7/02 | 0 011 | 0.002 | 0.025 | 0.002 | 0.037 | 0.049 | 0.071 | 0.024 | 0.032 | 0.023 | 0.013 | 0.025 | 0.000 | 0.026 | 0.006 | 0.013 | 0.040 | 51.8% |
| 7/03 | 0.027 | 0.002 | 0.037 | 0.102 | 0.044 | 0.049 | 0.157 | 0.031 | 0.041 | 0.030 | 0.034 | 0.025 | 0.000 | 0.050 | 0.013 | 0.022 | 0.079 | 55.8% |
| 7/04 | 0.044 | 0.003 | 0.042 | 0.119 | 0.044 | 0.064 | 0.168 | 0.031 | 0.050 | 0.051 | 0.034 | 0.037 | 0.000 | 0.059 | 0.014 | 0.029 | 0.089 | 50.9% |
| 7/05 | 0.060 | 0.003 | 0.082 | 0.193 | 0.056 | 0.084 | 0.168 | 0.033 | 0.060 | 0.051 | 0.063 | 0.060 | 0.005 | 0.078 | 0.017 | 0.041 | 0.114 | 47.1% |
| 7/06 | 0.067 | 0.025 | 0.088 | 0.193 | 0.070 | 0.125 | 0.245 | 0.038 | 0.060 | 0.109 | 0.083 | 0.070 | 0.010 | 0.100 | 0.020 | 0.057 | 0.144 | 43.3% |
| 7/07 | 0.083 | 0.031 | 0.088 | 0.213 | 0.090 | 0.193 | 0.253 | 0.069 | 0.067 | 0.124 | 0.107 | 0.080 | 0.040 | 0.120 | 0.021 | 0.074 | 0.166 | 38.2% |
| 7/08 | 0.131 | 0.031 | 0.108 | 0.226 | 0.099 | 0.193 | 0.268 | 0.069 | 0.077 | 0.201 | 0.119 | 0.098 | 0.040 | 0.138 | 0.022 | 0.090 | 0.187 | 35.1% |
| 7/09 | 0.131 | 0.044 | 0.115 | 0.250 | 0.120 | 0.350 | 0.268 | 0.115 | 0.102 | 0.238 | 0.126 | 0.122 | 0.059 | 0.169 | 0.028 | 0.108 | 0.230 | 36.0% |
| 7/10 | 0.140 | 0.070 | 0.133 | 0.321 | 0.158 | 0.350 | 0.275 | 0.130 | 0.109 | 0.287 | 0.139 | 0.122 | 0.078 | 0.192 | 0.029 | 0.129 | 0.256 | 33.1% |
| 7/11 | 0.149 | 0.112 | 0.174 | 0.328 | 0.158 | 0.460 | 0.275 | 0.142 | 0.124 | 0.379 | 0.139 | 0.141 | 0.086 | 0.222 | 0.036 | 0.143 | 0.300 | 35.3% |
| 7/12 | 0.157 | 0.124 | 0.183 | 0.367 | 0.223 | 0.510 | 0.303 | 0.154 | 0.148 | 0.379 | 0.179 | 0.166 | 0.090 | 0.248 | 0.038 | 0.166 | 0.330 | 33.0% |
| 7/13 | 0.165 | 0.165 | 0.242 | 0.367 | 0.284 | 0.569 | 0.328 | 0.154 | 0.148 | 0.439 | 0.202 | 0.177 | 0.110 | 0.279 | 0.041 | 0.189 | 0.368 | 32.2% |
| 7/14 | 0.179 | 0.276 | 0.242 | 0.380 | 0.300 | 0.574 | 0.364 | 0.210 | 0.254 | 0.467 | 0.229 | 0.208 | 0.135 | 0.316 | 0.036 | 0.237 | 0.395 | 25.0% |
| 7/15 | 0.225 | 0.276 | 0.385 | 0.419 | 0.351 | 0.574 | 0.487 | 0.210 | 0.284 | 0.511 | 0.296 | 0.252 | 0.135 | 0.365 | 0.036 | 0.286 | 0.445 | 21.7% |
| 7/16 | 0.225 | 0.402 | 0.420 | 0.438 | 0.372 | 0.584 | 0.487 | 0.244 | 0.324 | 0.542 | 0.316 | 0.310 | 0.244 | 0.396 | 0.035 | 0.320 | 0.471 | 19.0% |
| 7/17 | 0.294 | 0.459 | 0.457 | 0.476 | 0.394 | 0.584 | 0.593 | 0.356 | 0.406 | 0.586 | 0.390 | 0.310 | 0.293 | 0.454 | 0.030 | 0.389 | 0.519 | 14.4% |
| 7/18 | 0.345 | 0.473 | 0.490 | 0.499 | 0.394 | 0.584 | 0.650 | 0.416 | 0.433 | 0.632 | 0.390 | 0.380 | 0.330 | 0.482 | 0.031 | 0.416 | 0.549 | 13.8% |
| 7/19 | 0.401 | 0.473 | 0.516 | 0.529 | 0.476 | 0.663 | 0.711 | 0.426 | 0.466 | 0.632 | 0.503 | 0.434 | 0.386 | 0.527 | 0.030 | 0.461 | 0.592 | 12.5% |

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## Appendix C3.-Page 2 of 2.

| | Daily cumulative proportions [P(t)] by year of harvest by unguided anglers | | | | | | | | | | | | | | | 95% Confidence Interval | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Mean | SE | Low | High | RP[a] |
| 7/20 | 0.485 | 0.488 | 0.543 | 0.529 | 0.510 | 0.663 | 0.718 | 0.480 | 0.466 | 0.656 | 0.573 | 0.496 | 0.433 | 0.556 | 0.026 | 0.499 | 0.612 | 10.2% |
| 7/21 | 0 595 | 0.494 | 0.543 | 0.565 | 0.632 | 0.714 | 0.730 | 0.525 | 0.531 | 0.685 | 0.609 | 0.556 | 0.557 | 0.602 | 0.024 | 0.549 | 0.655 | 8.7% |
| 7/22 | 0.705 | 0.494 | 0.548 | 0.596 | 0.731 | 0.725 | 0.832 | 0.525 | 0.562 | 0.709 | 0.632 | 0.678 | 0.557 | 0.642 | 0.032 | 0.572 | 0.711 | 10.8% |
| 7/23 | 0.705 | 0.565 | 0.574 | 0.615 | 0.774 | 0.751 | 0.832 | 0.539 | 0.806 | 0.722 | 0.680 | 0.786 | 0.563 | 0.688 | 0.031 | 0.621 | 0.754 | 9.7% |
| 7/24 | 0.771 | 0.602 | 0.623 | 0.670 | 0.827 | 0.751 | 0.932 | 0.596 | 0.818 | 0.744 | 0.727 | 0.786 | 0.627 | 0.733 | 0.032 | 0.664 | 0.801 | 9.4% |
| 7/25 | 0.820 | 0.674 | 0.683 | 0.704 | 0.827 | 0.758 | 0.971 | 0.596 | 0.822 | 0.779 | 0.748 | 0.824 | 0.681 | 0.762 | 0.030 | 0.696 | 0.828 | 8.6% |
| 7/26 | 0.835 | 0.755 | 0.731 | 0.752 | 0.902 | 0.784 | 0.989 | 0.664 | 0.822 | 0.779 | 0.770 | 0.847 | 0.769 | 0.799 | 0.026 | 0.741 | 0.856 | 7.2% |
| 7/27 | 0.860 | 0.838 | 0.794 | 0.752 | 0.913 | 0.800 | 1.000 | 0.779 | 0.822 | 0.839 | 0.802 | 0.886 | 0.797 | 0.836 | 0.021 | 0.791 | 0.882 | 5.4% |
| 7/28 | 0.881 | 0.935 | 0.794 | 0.813 | 0.915 | 0.964 | 1.000 | 0.954 | 0.822 | 0.893 | 0.833 | 0.963 | 0.998 | 0.891 | 0.021 | 0.846 | 0.937 | 5.1% |
| 7/29 | 0.936 | 0.935 | 0.875 | 0.858 | 0.947 | 0.981 | 1.000 | 0.954 | 0.822 | 0.936 | 0.858 | 0.972 | 0.998 | 0.918 | 0.017 | 0.881 | 0.955 | 4.0% |
| 7/30 | 0.936 | 0.972 | 0.926 | 0.903 | 0.969 | 1.000 | 1.000 | 0.987 | 0.901 | 0.970 | 0.897 | 0.986 | 0.998 | 0.951 | 0.012 | 0.925 | 0.977 | 2.7% |
| 7/31 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 0.000 | 1.000 | 1.000 | 0.0% |

[a] Relative precision of the 95% confidence interval.

**Appendix C4.-Historical daily cumulative proportions of the catch of chinook salmon by unguided anglers during the return of late-run chinook salmon to the Kenai River, 1984-1996.**

| | Daily cumulative proportions [P(t)] by year of catch by unguided anglers | | | | | | | | | | | | | | | 95% Confidence Interval | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Mean | SE | Low | High | RP[a] |
| 7/01 | 0.002 | 0.002 | 0.013 | 0.001 | 0.021 | 0.014 | 0.057 | 0.000 | 0.063 | 0.016 | 0.008 | 0.014 | 0.000 | 0.018 | 0.007 | 0.004 | 0.032 | 80.3% |
| 7/02 | 0.009 | 0.002 | 0.017 | 0.001 | 0.029 | 0.044 | 0.057 | 0.033 | 0.076 | 0.030 | 0.019 | 0.032 | 0.000 | 0.029 | 0.007 | 0.014 | 0.044 | 52.5% |
| 7/03 | 0.023 | 0.003 | 0.034 | 0.077 | 0.039 | 0.044 | 0.115 | 0.039 | 0.081 | 0.037 | 0.042 | 0.032 | 0.000 | 0.049 | 0.009 | 0.028 | 0.069 | 41.9% |
| 7/04 | 0.040 | 0.003 | 0.048 | 0.106 | 0.039 | 0.094 | 0.122 | 0.046 | 0.088 | 0.058 | 0.042 | 0.046 | 0.000 | 0.062 | 0.011 | 0.039 | 0.086 | 37.3% |
| 7/05 | 0.061 | 0.003 | 0.080 | 0.173 | 0.048 | 0.133 | 0.122 | 0.052 | 0.094 | 0.058 | 0.067 | 0.079 | 0.004 | 0.081 | 0.014 | 0.050 | 0.112 | 38.0% |
| 7/06 | 0.072 | 0.018 | 0.089 | 0.173 | 0.064 | 0.163 | 0.200 | 0.059 | 0.094 | 0.109 | 0.090 | 0.117 | 0.012 | 0.103 | 0.016 | 0.067 | 0.139 | 35.0% |
| 7/07 | 0.100 | 0.024 | 0.089 | 0.191 | 0.090 | 0.227 | 0.217 | 0.084 | 0.110 | 0.123 | 0.115 | 0.126 | 0.050 | 0.125 | 0.019 | 0.084 | 0.165 | 32.8% |
| 7/08 | 0.137 | 0.024 | 0.122 | 0.205 | 0.102 | 0.227 | 0.235 | 0.084 | 0.116 | 0.204 | 0.134 | 0.138 | 0.050 | 0.145 | 0.020 | 0.101 | 0.188 | 30.0% |
| 7/09 | 0.137 | 0.038 | 0.128 | 0.230 | 0.124 | 0.327 | 0.235 | 0.123 | 0.145 | 0.250 | 0.139 | 0.161 | 0.065 | 0.170 | 0.024 | 0.117 | 0.223 | 31.1% |
| 7/10 | 0.144 | 0.066 | 0.138 | 0.283 | 0.178 | 0.327 | 0.245 | 0.136 | 0.157 | 0.324 | 0.149 | 0.161 | 0.080 | 0.195 | 0.026 | 0.139 | 0.252 | 29.0% |
| 7/11 | 0.153 | 0.112 | 0.174 | 0.295 | 0.178 | 0.420 | 0.259 | 0.146 | 0.177 | 0.407 | 0.149 | 0.191 | 0.087 | 0.225 | 0.032 | 0.154 | 0.295 | 31.3% |
| 7/12 | 0.160 | 0.127 | 0.180 | 0.344 | 0.256 | 0.487 | 0.313 | 0.156 | 0.200 | 0.407 | 0.178 | 0.210 | 0.090 | 0.255 | 0.035 | 0.178 | 0.332 | 30.3% |
| 7/13 | 0.168 | 0.159 | 0.270 | 0.344 | 0.336 | 0.524 | 0.340 | 0.156 | 0.200 | 0.465 | 0.198 | 0.220 | 0.107 | 0.287 | 0.038 | 0.204 | 0.370 | 28.9% |
| 7/14 | 0.180 | 0.276 | 0.270 | 0.370 | 0.356 | 0.529 | 0.393 | 0.203 | 0.281 | 0.500 | 0.221 | 0.246 | 0.143 | 0.325 | 0.035 | 0.249 | 0.401 | 23.4% |
| 7/15 | 0.218 | 0.276 | 0.444 | 0.402 | 0.395 | 0.529 | 0.475 | 0.203 | 0.301 | 0.554 | 0.270 | 0.288 | 0.143 | 0.370 | 0.037 | 0.289 | 0.451 | 21.9% |
| 7/16 | 0.218 | 0.414 | 0.470 | 0.424 | 0.415 | 0.539 | 0.475 | 0.294 | 0.333 | 0.579 | 0.296 | 0.342 | 0.285 | 0.405 | 0.033 | 0.333 | 0.478 | 17.9% |
| 7/17 | 0.301 | 0.484 | 0.505 | 0.471 | 0.433 | 0.539 | 0.662 | 0.388 | 0.381 | 0.614 | 0.368 | 0.342 | 0.325 | 0.468 | 0.033 | 0.396 | 0.539 | 15.3% |
| 7/18 | 0.372 | 0.497 | 0.528 | 0.499 | 0.433 | 0.672 | 0.707 | 0.439 | 0.422 | 0.656 | 0.368 | 0.416 | 0.360 | 0.508 | 0.036 | 0.429 | 0.588 | 15.6% |
| 7/19 | 0.430 | 0.499 | 0.545 | 0.530 | 0.529 | 0.723 | 0.748 | 0.446 | 0.450 | 0.656 | 0.499 | 0.464 | 0.426 | 0.550 | 0.033 | 0.478 | 0.623 | 13.2% |

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## Appendix C4.-Page 2 of 2.

| | Daily cumulative proportions [P(t)] by year of catch by unguided anglers | | | | | | | | | | | | | | | 95% Confidence Interval | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Mean | SE | Low | High | RP[a] |
| 7/20 | 0.509 | 0.516 | 0.559 | 0.530 | 0.556 | 0.723 | 0.763 | 0.500 | 0.450 | 0.675 | 0.574 | 0.506 | 0.464 | 0.578 | 0.030 | 0.512 | 0.643 | 11.3% |
| 7/21 | 0.598 | 0.522 | 0.559 | 0.571 | 0.669 | 0.755 | 0.790 | 0.538 | 0.488 | 0.699 | 0.609 | 0.572 | 0.597 | 0.618 | 0.030 | 0.554 | 0.683 | 10.4% |
| 7/22 | 0.718 | 0.522 | 0.566 | 0.598 | 0.754 | 0.773 | 0.874 | 0.538 | 0.526 | 0.726 | 0.638 | 0.675 | 0.597 | 0.658 | 0.036 | 0.580 | 0.735 | 11.9% |
| 7/23 | 0.718 | 0.587 | 0.586 | 0.617 | 0.787 | 0.795 | 0.874 | 0.549 | 0.675 | 0.737 | 0.692 | 0.781 | 0.602 | 0.693 | 0.031 | 0.625 | 0.760 | 9.7% |
| 7/24 | 0.778 | 0.625 | 0.619 | 0.663 | 0.834 | 0.795 | 0.948 | 0.614 | 0.709 | 0.754 | 0.733 | 0.781 | 0.673 | 0.734 | 0.031 | 0.666 | 0.802 | 9.3% |
| 7/25 | 0.826 | 0.683 | 0.679 | 0.704 | 0.834 | 0.799 | 0.981 | 0.614 | 0.747 | 0.785 | 0.756 | 0.828 | 0.718 | 0.764 | 0.030 | 0.699 | 0.829 | 8.5% |
| 7/26 | 0.846 | 0.754 | 0.719 | 0.757 | 0.912 | 0.833 | 0.992 | 0.671 | 0.792 | 0.785 | 0.772 | 0.860 | 0.788 | 0.803 | 0.027 | 0.744 | 0.862 | 7.4% |
| 7/27 | 0.871 | 0.833 | 0.770 | 0.757 | 0.923 | 0.843 | 1.000 | 0.768 | 0.792 | 0.845 | 0.801 | 0.894 | 0.814 | 0.837 | 0.022 | 0.788 | 0.885 | 5.8% |
| 7/28 | 0.898 | 0.907 | 0.770 | 0.823 | 0.927 | 0.973 | 1.000 | 0.960 | 0.829 | 0.899 | 0.847 | 0.954 | 0.999 | 0.894 | 0.021 | 0.847 | 0.940 | 5.2% |
| 7/29 | 0.946 | 0.907 | 0.847 | 0.867 | 0.951 | 0.984 | 1.000 | 0.960 | 0.874 | 0.945 | 0.875 | 0.962 | 0.999 | 0.923 | 0.016 | 0.889 | 0.957 | 3.7% |
| 7/30 | 0.946 | 0.975 | 0.917 | 0.908 | 0.974 | 1.000 | 1.000 | 0.989 | 0.937 | 0.970 | 0.911 | 0.989 | 0.999 | 0.957 | 0.011 | 0.934 | 0.980 | 2.4% |
| 7/31 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 0.000 | 1.000 | 1.000 | 0.0% |

[a] Relative precision of the 95% confidence interval.

**Appendix C5.-Historical daily cumulative proportions of the effort by guided anglers during the return of late-run chinook salmon to the Kenai River, 1984-1996.**

| | Daily cumulative proportions [P(t)] by year of guided angler effort | | | | | | | | | | | | | | | 95% Confidence Interval | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Mean | SE | Low | High | RP[a] |
| 7/01 | 0.000 | 0.023 | 0.025 | 0.006 | 0.025 | 0.032 | 0.000 | 0.000 | 0.035 | 0.021 | 0.025 | 0.037 | 0.000 | 0.017 | 0.004 | 0.009 | 0.026 | 49.8% |
| 7/02 | 0.014 | 0.029 | 0.039 | 0.028 | 0.045 | 0.032 | 0.000 | 0.033 | 0.059 | 0.046 | 0.047 | 0.037 | 0.031 | 0.034 | 0.005 | 0.023 | 0.045 | 31.9% |
| 7/03 | 0.027 | 0.033 | 0.055 | 0.055 | 0.045 | 0.032 | 0.045 | 0.063 | 0.088 | 0.068 | 0.047 | 0.037 | 0.061 | 0.051 | 0.005 | 0.039 | 0.062 | 23.0% |
| 7/04 | 0.047 | 0.044 | 0.079 | 0.077 | 0.045 | 0.073 | 0.076 | 0.092 | 0.109 | 0.068 | 0.047 | 0.083 | 0.083 | 0.069 | 0.006 | 0.055 | 0.083 | 20.2% |
| 7/05 | 0.073 | 0.064 | 0.103 | 0.077 | 0.079 | 0.104 | 0.102 | 0.131 | 0.109 | 0.068 | 0.086 | 0.123 | 0.103 | 0.091 | 0.006 | 0.077 | 0.104 | 15.1% |
| 7/06 | 0.123 | 0.087 | 0.103 | 0.077 | 0.111 | 0.140 | 0.134 | 0.162 | 0.109 | 0.107 | 0.120 | 0.160 | 0.126 | 0.116 | 0.007 | 0.100 | 0.131 | 13.7% |
| 7/07 | 0.199 | 0.087 | 0.103 | 0.107 | 0.138 | 0.179 | 0.173 | 0.162 | 0.151 | 0.128 | 0.163 | 0.201 | 0.126 | 0.145 | 0.011 | 0.121 | 0.168 | 16.0% |
| 7/08 | 0.199 | 0.087 | 0.152 | 0.129 | 0.173 | 0.213 | 0.173 | 0.162 | 0.188 | 0.162 | 0.196 | 0.247 | 0.126 | 0.167 | 0.011 | 0.143 | 0.190 | 14.0% |
| 7/09 | 0.199 | 0.122 | 0.181 | 0.172 | 0.211 | 0.213 | 0.173 | 0.223 | 0.217 | 0.189 | 0.226 | 0.247 | 0.174 | 0.193 | 0.009 | 0.173 | 0.213 | 10.4% |
| 7/10 | 0.252 | 0.169 | 0.206 | 0.204 | 0.211 | 0.213 | 0.232 | 0.263 | 0.250 | 0.232 | 0.226 | 0.247 | 0.189 | 0.223 | 0.008 | 0.206 | 0.241 | 7.9% |
| 7/11 | 0.320 | 0.228 | 0.242 | 0.225 | 0.211 | 0.276 | 0.290 | 0.309 | 0.291 | 0.232 | 0.226 | 0.299 | 0.234 | 0.259 | 0.012 | 0.234 | 0.284 | 9.8% |
| 7/12 | 0.360 | 0.279 | 0.294 | 0.225 | 0.267 | 0.335 | 0.349 | 0.344 | 0.291 | 0.232 | 0.302 | 0.334 | 0.293 | 0.298 | 0.014 | 0.268 | 0.328 | 10.1% |
| 7/13 | 0.412 | 0.322 | 0.294 | 0.225 | 0.319 | 0.388 | 0.409 | 0.388 | 0.291 | 0.292 | 0.356 | 0.377 | 0.343 | 0.336 | 0.018 | 0.297 | 0.375 | 11.7% |
| 7/14 | 0.484 | 0.322 | 0.294 | 0.308 | 0.374 | 0.444 | 0.459 | 0.388 | 0.349 | 0.346 | 0.404 | 0.411 | 0.343 | 0.379 | 0.019 | 0.338 | 0.421 | 10.9% |
| 7/15 | 0.484 | 0.322 | 0.339 | 0.384 | 0.408 | 0.493 | 0.459 | 0.388 | 0.398 | 0.397 | 0.454 | 0.448 | 0.343 | 0.411 | 0.017 | 0.375 | 0.448 | 8.9% |
| 7/16 | 0.484 | 0.416 | 0.392 | 0.437 | 0.461 | 0.493 | 0.459 | 0.444 | 0.443 | 0.442 | 0.510 | 0.448 | 0.411 | 0.453 | 0.010 | 0.431 | 0.475 | 4.9% |
| 7/17 | 0.534 | 0.485 | 0.455 | 0.486 | 0.461 | 0.493 | 0.507 | 0.509 | 0.475 | 0.485 | 0.510 | 0.448 | 0.451 | 0.491 | 0.007 | 0.476 | 0.506 | 3.1% |
| 7/18 | 0.609 | 0.530 | 0.510 | 0.538 | 0.461 | 0.565 | 0.628 | 0.551 | 0.521 | 0.485 | 0.510 | 0.516 | 0.514 | 0.537 | 0.015 | 0.504 | 0.570 | 6.1% |
| 7/19 | 0.654 | 0.577 | 0.569 | 0.538 | 0.527 | 0.621 | 0.692 | 0.604 | 0.521 | 0.485 | 0.564 | 0.583 | 0.573 | 0.577 | 0.019 | 0.537 | 0.618 | 7.0% |

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## Appendix C5.-Page 2 of 2.

| | Daily cumulative proportions [P(t)] by year of guided angler effort | | | | | | | | | | | | | | | 95% Confidence Interval | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Mean | SE | Low | High | RP[a] |
| 7/20 | 0.723 | 0.627 | 0.569 | 0.538 | 0.591 | 0.674 | 0.736 | 0.655 | 0.521 | 0.555 | 0.618 | 0.622 | 0.642 | 0.619 | 0.022 | 0.571 | 0.666 | 7.7% |
| 7/21 | 0.737 | 0.627 | 0.569 | 0.596 | 0.650 | 0.724 | 0.793 | 0.655 | 0.608 | 0.616 | 0.660 | 0.677 | 0.642 | 0.658 | 0.020 | 0.613 | 0.702 | 6.8% |
| 7/22 | 0.737 | 0.627 | 0.617 | 0.630 | 0.685 | 0.774 | 0.793 | 0.655 | 0.669 | 0.674 | 0.701 | 0.751 | 0.642 | 0.687 | 0.018 | 0.649 | 0.726 | 5.6% |
| 7/23 | 0.737 | 0.677 | 0.645 | 0.679 | 0.745 | 0.774 | 0.793 | 0.713 | 0.730 | 0.709 | 0.744 | 0.751 | 0.698 | 0.722 | 0.013 | 0.694 | 0.751 | 4.0% |
| 7/24 | 0.793 | 0.731 | 0.705 | 0.735 | 0.745 | 0.774 | 0.866 | 0.767 | 0.763 | 0.760 | 0.744 | 0.751 | 0.757 | 0.762 | 0.013 | 0.735 | 0.790 | 3.6% |
| 7/25 | 0.842 | 0.790 | 0.770 | 0.782 | 0.745 | 0.837 | 0.918 | 0.813 | 0.785 | 0.760 | 0.784 | 0.807 | 0.812 | 0.802 | 0.015 | 0.770 | 0.834 | 4.0% |
| 7/26 | 0.874 | 0.841 | 0.829 | 0.782 | 0.807 | 0.884 | 0.962 | 0.859 | 0.785 | 0.760 | 0.816 | 0.865 | 0.877 | 0.836 | 0.017 | 0.799 | 0.874 | 4.5% |
| 7/27 | 0.926 | 0.918 | 0.829 | 0.782 | 0.864 | 0.922 | 0.990 | 0.912 | 0.785 | 0.822 | 0.866 | 0.912 | 0.933 | 0.874 | 0.020 | 0.831 | 0.917 | 4.9% |
| 7/28 | 0.951 | 0.918 | 0.829 | 0.842 | 0.915 | 0.961 | 0.995 | 0.912 | 0.825 | 0.870 | 0.920 | 0.959 | 0.933 | 0.903 | 0.017 | 0.867 | 0.940 | 4.1% |
| 7/29 | 0.951 | 0.918 | 0.902 | 0.894 | 0.960 | 1.000 | 0.995 | 0.912 | 0.857 | 0.923 | 0.957 | 0.989 | 0.933 | 0.934 | 0.013 | 0.905 | 0.962 | 3.1% |
| 7/30 | 0.951 | 0.960 | 0.961 | 0.944 | 1.000 | 1.000 | 0.995 | 0.960 | 0.929 | 0.967 | 1.000 | 0.989 | 0.972 | 0.970 | 0.008 | 0.953 | 0.986 | 1.7% |
| 7/31 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 0.000 | 1.000 | 1.000 | 0.0% |

[a] Relative precision of the 95% confidence interval.

**Appendix C6.-Historical daily cumulative proportions of the harvest of chinook salmon by guided anglers during the return of late-run chinook salmon to the Kenai River, 1984-1996.**

| | Daily cumulative proportions [P(t)] by year of harvest by guided anglers | | | | | | | | | | | | | | | 95% Confidence Interval | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Mean | SE | Low | High | RP[a] |
| 7/01 | 0.000 | 0.037 | 0.013 | 0.008 | 0.026 | 0.013 | 0.000 | 0.000 | 0.045 | 0.029 | 0.034 | 0.028 | 0.000 | 0.019 | 0.005 | 0.008 | 0.029 | 57.5% |
| 7/02 | 0.008 | 0.039 | 0.019 | 0.041 | 0.034 | 0.013 | 0.000 | 0.031 | 0.059 | 0.047 | 0.057 | 0.028 | 0.012 | 0.032 | 0.006 | 0.019 | 0.044 | 40.5% |
| 7/03 | 0.030 | 0.041 | 0.030 | 0.085 | 0.034 | 0.013 | 0.027 | 0.068 | 0.059 | 0.059 | 0.057 | 0.028 | 0.039 | 0.046 | 0.006 | 0.032 | 0.060 | 30.8% |
| 7/04 | 0.055 | 0.047 | 0.049 | 0.118 | 0.034 | 0.060 | 0.072 | 0.079 | 0.066 | 0.059 | 0.057 | 0.056 | 0.052 | 0.063 | 0.007 | 0.049 | 0.078 | 22.8% |
| 7/05 | 0.080 | 0.058 | 0.055 | 0.118 | 0.064 | 0.085 | 0.107 | 0.079 | 0.066 | 0.059 | 0.117 | 0.080 | 0.054 | 0.081 | 0.007 | 0.065 | 0.096 | 19.4% |
| 7/06 | 0.128 | 0.079 | 0.055 | 0.118 | 0.111 | 0.136 | 0.167 | 0.129 | 0.066 | 0.097 | 0.153 | 0.145 | 0.064 | 0.113 | 0.011 | 0.089 | 0.136 | 20.7% |
| 7/07 | 0.197 | 0.079 | 0.055 | 0.157 | 0.129 | 0.220 | 0.201 | 0.129 | 0.088 | 0.125 | 0.209 | 0.196 | 0.064 | 0.144 | 0.017 | 0.107 | 0.182 | 25.9% |
| 7/08 | 0.197 | 0.079 | 0.088 | 0.179 | 0.169 | 0.241 | 0.201 | 0.129 | 0.118 | 0.187 | 0.248 | 0.216 | 0.064 | 0.167 | 0.017 | 0.129 | 0.204 | 22.4% |
| 7/09 | 0.197 | 0.109 | 0.102 | 0.215 | 0.193 | 0.241 | 0.201 | 0.129 | 0.127 | 0.230 | 0.290 | 0.216 | 0.103 | 0.185 | 0.018 | 0.145 | 0.225 | 21.5% |
| 7/10 | 0.223 | 0.155 | 0.109 | 0.237 | 0.193 | 0.241 | 0.237 | 0.154 | 0.155 | 0.298 | 0.290 | 0.216 | 0.132 | 0.208 | 0.018 | 0.169 | 0.248 | 19.1% |
| 7/11 | 0.249 | 0.217 | 0.143 | 0.244 | 0.193 | 0.316 | 0.262 | 0.211 | 0.202 | 0.298 | 0.290 | 0.260 | 0.181 | 0.239 | 0.016 | 0.205 | 0.273 | 14.2% |
| 7/12 | 0.264 | 0.248 | 0.164 | 0.244 | 0.271 | 0.367 | 0.343 | 0.234 | 0.202 | 0.298 | 0.348 | 0.281 | 0.243 | 0.271 | 0.019 | 0.229 | 0.313 | 15.3% |
| 7/13 | 0.301 | 0.281 | 0.164 | 0.244 | 0.297 | 0.469 | 0.407 | 0.246 | 0.202 | 0.375 | 0.391 | 0.302 | 0.273 | 0.307 | 0.028 | 0.245 | 0.369 | 20.1% |
| 7/14 | 0.332 | 0.281 | 0.164 | 0.297 | 0.346 | 0.496 | 0.442 | 0.246 | 0.311 | 0.440 | 0.427 | 0.339 | 0.273 | 0.344 | 0.030 | 0.279 | 0.409 | 18.9% |
| 7/15 | 0.332 | 0.281 | 0.207 | 0.345 | 0.392 | 0.508 | 0.442 | 0.246 | 0.380 | 0.501 | 0.482 | 0.382 | 0.273 | 0.374 | 0.031 | 0.307 | 0.442 | 18.1% |
| 7/16 | 0.332 | 0.374 | 0.283 | 0.387 | 0.424 | 0.508 | 0.442 | 0.321 | 0.418 | 0.552 | 0.528 | 0.382 | 0.481 | 0.415 | 0.026 | 0.358 | 0.473 | 13.9% |
| 7/17 | 0.384 | 0.428 | 0.330 | 0.442 | 0.424 | 0.508 | 0.528 | 0.347 | 0.445 | 0.591 | 0.528 | 0.382 | 0.525 | 0.450 | 0.025 | 0.397 | 0.504 | 11.9% |
| 7/18 | 0.438 | 0.444 | 0.407 | 0.475 | 0.424 | 0.635 | 0.649 | 0.422 | 0.469 | 0.591 | 0.528 | 0.581 | 0.564 | 0.498 | 0.027 | 0.440 | 0.557 | 11.7% |
| 7/19 | 0.483 | 0.469 | 0.446 | 0.475 | 0.490 | 0.709 | 0.709 | 0.514 | 0.469 | 0.591 | 0.603 | 0.629 | 0.622 | 0.542 | 0.029 | 0.478 | 0.605 | 11.7% |

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## Appendix C6.-Page 2 of 2.

| | Daily cumulative proportions [P(t)] by year of harvest by guided anglers | | | | | | | | | | | | | | | 95% Confidence Interval | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Mean | SE | Low | High | RP[a] |
| 7/20 | 0.578 | 0.493 | 0.446 | 0.475 | 0.529 | 0.720 | 0.734 | 0.571 | 0.469 | 0.608 | 0.678 | 0.663 | 0.710 | 0.573 | 0.031 | 0.505 | 0.640 | 11.7% |
| 7/21 | 0.606 | 0.493 | 0.446 | 0.513 | 0.592 | 0.753 | 0.821 | 0.571 | 0.515 | 0.665 | 0.705 | 0.722 | 0.710 | 0.607 | 0.035 | 0.530 | 0.684 | 12.7% |
| 7/22 | 0.606 | 0.493 | 0.495 | 0.541 | 0.680 | 0.809 | 0.821 | 0.571 | 0.596 | 0.684 | 0.738 | 0.813 | 0.710 | 0.640 | 0.035 | 0.563 | 0.716 | 11.9% |
| 7/23 | 0.606 | 0.607 | 0.509 | 0.619 | 0.778 | 0.809 | 0.821 | 0.600 | 0.628 | 0.706 | 0.768 | 0.813 | 0.739 | 0.677 | 0.031 | 0.609 | 0.745 | 10.1% |
| 7/24 | 0.688 | 0.675 | 0.561 | 0.682 | 0.778 | 0.809 | 0.882 | 0.647 | 0.628 | 0.737 | 0.768 | 0.813 | 0.762 | 0.714 | 0.028 | 0.654 | 0.774 | 8.4% |
| 7/25 | 0.748 | 0.743 | 0.627 | 0.742 | 0.778 | 0.868 | 0.916 | 0.696 | 0.628 | 0.737 | 0.794 | 0.861 | 0.833 | 0.752 | 0.027 | 0.695 | 0.810 | 7.7% |
| 7/26 | 0.820 | 0.761 | 0.664 | 0.742 | 0.863 | 0.899 | 0.969 | 0.754 | 0.628 | 0.737 | 0.819 | 0.896 | 0.912 | 0.787 | 0.030 | 0.721 | 0.853 | 8.4% |
| 7/27 | 0.903 | 0.876 | 0.664 | 0.742 | 0.905 | 0.943 | 0.983 | 0.848 | 0.628 | 0.812 | 0.887 | 0.924 | 0.971 | 0.836 | 0.034 | 0.761 | 0.910 | 8.9% |
| 7/28 | 0.924 | 0.876 | 0.664 | 0.794 | 0.923 | 1.000 | 0.985 | 0.848 | 0.633 | 0.882 | 0.941 | 0.975 | 0.971 | 0.861 | 0.036 | 0.782 | 0.940 | 9.2% |
| 7/29 | 0.924 | 0.876 | 0.818 | 0.853 | 0.956 | 1.000 | 0.985 | 0.848 | 0.633 | 0.917 | 0.965 | 0.988 | 0.971 | 0.889 | 0.031 | 0.820 | 0.957 | 7.7% |
| 7/30 | 0.924 | 0.936 | 0.924 | 0.906 | 1.000 | 1.000 | 0.985 | 0.945 | 0.843 | 0.983 | 1.000 | 0.988 | 0.983 | 0.950 | 0.015 | 0.917 | 0.982 | 3.4% |
| 7/31 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 0.000 | 1.000 | 1.000 | 0.0% |

[a] Relative precision of the 95% confidence interval.

**Appendix C7.-Historical daily cumulative proportions of the catch of chinook salmon by guided anglers during the return of late-run chinook salmon to the Kenai River, 1984-1996.**

| | Daily cumulative proportions [P(t)] by year of catch by guided anglers | | | | | | | | | | | | | | | 95% Confidence Interval | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Mean | SE | Low | High | RP[a] |
| 7/01 | 0.000 | 0.031 | 0.017 | 0.006 | 0.019 | 0.011 | 0.000 | 0.000 | 0.036 | 0.024 | 0.031 | 0.027 | 0.000 | 0.016 | 0.004 | 0.007 | 0.025 | 55.4% |
| 7/02 | 0.010 | 0.033 | 0.027 | 0.040 | 0.025 | 0.011 | 0.000 | 0.033 | 0.045 | 0.044 | 0.051 | 0.027 | 0.010 | 0.029 | 0.005 | 0.018 | 0.040 | 37.2% |
| 7/03 | 0.026 | 0.034 | 0.036 | 0.080 | 0.025 | 0.011 | 0.030 | 0.063 | 0.045 | 0.062 | 0.051 | 0.027 | 0.034 | 0.042 | 0.006 | 0.029 | 0.055 | 31.7% |
| 7/04 | 0.047 | 0.038 | 0.059 | 0.114 | 0.025 | 0.049 | 0.064 | 0.072 | 0.051 | 0.062 | 0.051 | 0.062 | 0.048 | 0.058 | 0.007 | 0.043 | 0.073 | 25.9% |
| 7/05 | 0.072 | 0.045 | 0.069 | 0.114 | 0.051 | 0.080 | 0.095 | 0.092 | 0.051 | 0.062 | 0.117 | 0.093 | 0.051 | 0.077 | 0.008 | 0.061 | 0.093 | 21.2% |
| 7/06 | 0.117 | 0.061 | 0.069 | 0.114 | 0.094 | 0.125 | 0.148 | 0.132 | 0.051 | 0.098 | 0.160 | 0.165 | 0.069 | 0.106 | 0.011 | 0.083 | 0.130 | 21.8% |
| 7/07 | 0.176 | 0.061 | 0.069 | 0.160 | 0.112 | 0.193 | 0.181 | 0.132 | 0.067 | 0.124 | 0.212 | 0.219 | 0.069 | 0.135 | 0.016 | 0.100 | 0.171 | 26.2% |
| 7/08 | 0.176 | 0.061 | 0.114 | 0.179 | 0.141 | 0.217 | 0.181 | 0.132 | 0.088 | 0.176 | 0.249 | 0.241 | 0.069 | 0.156 | 0.017 | 0.120 | 0.192 | 23.3% |
| 7/09 | 0.176 | 0.115 | 0.127 | 0.217 | 0.160 | 0.217 | 0.181 | 0.136 | 0.095 | 0.217 | 0.286 | 0.241 | 0.136 | 0.175 | 0.017 | 0.138 | 0.212 | 21.1% |
| 7/10 | 0.202 | 0.181 | 0.135 | 0.234 | 0.160 | 0.217 | 0.208 | 0.165 | 0.132 | 0.281 | 0.286 | 0.241 | 0.169 | 0.200 | 0.016 | 0.166 | 0.235 | 17.2% |
| 7/11 | 0.239 | 0.257 | 0.163 | 0.241 | 0.160 | 0.320 | 0.234 | 0.218 | 0.166 | 0.281 | 0.286 | 0.294 | 0.221 | 0.233 | 0.016 | 0.198 | 0.268 | 15.0% |
| 7/12 | 0.256 | 0.280 | 0.182 | 0.241 | 0.234 | 0.376 | 0.315 | 0.241 | 0.166 | 0.281 | 0.342 | 0.310 | 0.279 | 0.265 | 0.019 | 0.223 | 0.306 | 15.7% |
| 7/13 | 0.285 | 0.315 | 0.182 | 0.241 | 0.260 | 0.493 | 0.377 | 0.251 | 0.166 | 0.355 | 0.380 | 0.330 | 0.305 | 0.300 | 0.029 | 0.237 | 0.364 | 21.0% |
| 7/14 | 0.316 | 0.315 | 0.182 | 0.282 | 0.314 | 0.516 | 0.415 | 0.251 | 0.259 | 0.421 | 0.413 | 0.362 | 0.305 | 0.335 | 0.029 | 0.272 | 0.398 | 18.9% |
| 7/15 | 0.316 | 0.315 | 0.249 | 0.335 | 0.365 | 0.535 | 0.415 | 0.251 | 0.314 | 0.490 | 0.463 | 0.396 | 0.305 | 0.368 | 0.029 | 0.305 | 0.431 | 17.1% |
| 7/16 | 0.316 | 0.443 | 0.345 | 0.377 | 0.391 | 0.535 | 0.415 | 0.363 | 0.349 | 0.547 | 0.505 | 0.396 | 0.511 | 0.417 | 0.024 | 0.364 | 0.470 | 12.6% |
| 7/17 | 0.382 | 0.507 | 0.409 | 0.428 | 0.391 | 0.535 | 0.504 | 0.395 | 0.374 | 0.585 | 0.505 | 0.396 | 0.552 | 0.456 | 0.022 | 0.408 | 0.504 | 10.5% |
| 7/18 | 0.452 | 0.521 | 0.468 | 0.454 | 0.391 | 0.655 | 0.676 | 0.454 | 0.394 | 0.585 | 0.505 | 0.622 | 0.587 | 0.505 | 0.029 | 0.442 | 0.568 | 12.5% |
| 7/19 | 0.503 | 0.538 | 0.501 | 0.454 | 0.451 | 0.724 | 0.738 | 0.533 | 0.394 | 0.585 | 0.599 | 0.668 | 0.638 | 0.547 | 0.033 | 0.476 | 0.618 | 13.0% |

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## Appendix C7.-Page 2 of 2.

| | Daily cumulative proportions [P(t)] by year of catch by guided anglers | | | | | | | | | | | | | | | 95% Confidence Interval | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Mean | SE | Low | High | RP[a] |
| 7/20 | 0.606 | 0.557 | 0.501 | 0.454 | 0.489 | 0.733 | 0.766 | 0.588 | 0.394 | 0.602 | 0.687 | 0.697 | 0.716 | 0.580 | 0.035 | 0.503 | 0.656 | 13.2% |
| 7/21 | 0.631 | 0.557 | 0.501 | 0.494 | 0.610 | 0.763 | 0.837 | 0.588 | 0.427 | 0.657 | 0.711 | 0.762 | 0.716 | 0.616 | 0.037 | 0.536 | 0.696 | 13.1% |
| 7/22 | 0.631 | 0.557 | 0.534 | 0.524 | 0.698 | 0.809 | 0.837 | 0.588 | 0.499 | 0.680 | 0.739 | 0.838 | 0.716 | 0.645 | 0.035 | 0.568 | 0.722 | 11.9% |
| 7/23 | 0.631 | 0.665 | 0.545 | 0.598 | 0.788 | 0.809 | 0.837 | 0.613 | 0.523 | 0.700 | 0.767 | 0.838 | 0.742 | 0.680 | 0.033 | 0.608 | 0.751 | 10.5% |
| 7/24 | 0.721 | 0.719 | 0.583 | 0.654 | 0.788 | 0.809 | 0.893 | 0.675 | 0.553 | 0.729 | 0.767 | 0.838 | 0.778 | 0.717 | 0.030 | 0.652 | 0.782 | 9.1% |
| 7/25 | 0.777 | 0.780 | 0.641 | 0.735 | 0.788 | 0.860 | 0.937 | 0.724 | 0.576 | 0.729 | 0.792 | 0.883 | 0.841 | 0.758 | 0.029 | 0.694 | 0.822 | 8.4% |
| 7/26 | 0.840 | 0.794 | 0.681 | 0.735 | 0.869 | 0.905 | 0.977 | 0.792 | 0.576 | 0.729 | 0.813 | 0.913 | 0.915 | 0.792 | 0.033 | 0.719 | 0.864 | 9.1% |
| 7/27 | 0.912 | 0.910 | 0.681 | 0.735 | 0.921 | 0.945 | 0.987 | 0.878 | 0.576 | 0.808 | 0.876 | 0.940 | 0.970 | 0.839 | 0.038 | 0.756 | 0.922 | 9.9% |
| 7/28 | 0.929 | 0.910 | 0.681 | 0.809 | 0.935 | 0.995 | 0.989 | 0.878 | 0.638 | 0.880 | 0.923 | 0.979 | 0.970 | 0.870 | 0.035 | 0.793 | 0.946 | 8.8% |
| 7/29 | 0.929 | 0.910 | 0.826 | 0.861 | 0.962 | 1.000 | 0.989 | 0.878 | 0.659 | 0.920 | 0.946 | 0.991 | 0.970 | 0.898 | 0.029 | 0.836 | 0.961 | 7.0% |
| 7/30 | 0.929 | 0.957 | 0.927 | 0.919 | 1.000 | 1.000 | 0.989 | 0.955 | 0.855 | 0.976 | 1.000 | 0.991 | 0.981 | 0.955 | 0.014 | 0.926 | 0.985 | 3.1% |
| 7/31 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 0.000 | 1.000 | 1.000 | 0.0% |

[a] Relative precision of the 95% confidence interval.