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# Optimal Production of Chinook Salmon from the Situk River

**by**

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

## Symbols and Abbreviations

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**Weights and measures (metric)**

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

**Weights and measures (English)**

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

**Time and temperature**

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

**Physics and chemistry**

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

**General**

| | |
|---|---|
| Alaska Department of Fish and Game | ADF&G |
| Alaska Administrative Code | AAC |
| all commonly accepted abbreviations | e.g., Mr., Mrs., AM, PM, etc. |
| all commonly accepted professional titles | e.g., Dr., Ph.D., R.N., etc. |
| at | @ |
| compass directions: | |
| east | E |
| north | N |
| south | S |
| west | W |
| copyright | © |
| corporate suffixes: | |
| Company | Co. |
| Corporation | Corp. |
| Incorporated | Inc. |
| Limited | Ltd. |
| District of Columbia | D.C. |
| et alii (and others) | et al. |
| et cetera (and so forth) | etc. |
| exempli gratia (for example) | e.g. |
| Federal Information Code | FIC |
| id est (that is) | i.e. |
| latitude or longitude | lat. or long. |
| monetary symbols (U.S.) | $, ¢ |
| months (tables and figures): first three letters | Jan,...,Dec |
| registered trademark | ® |
| trademark | ™ |
| United States (adjective) | U.S. |
| United States of America (noun) | USA |
| U.S.C. | United States Code |
| U.S. state | use two-letter abbreviations (e.g., AK, WA) |

**Measures (fisheries)**

| | |
|---|---|
| fork length | FL |
| mideye-to-fork | MEF |
| mideye-to-tail-fork | METF |
| standard length | SL |
| total length | TL |

**Mathematics, statistics**

| | |
|---|---|
| *all standard mathematical signs, symbols and abbreviations* | |
| alternate hypothesis | $H_A$ |
| base of natural logarithm | $e$ |
| catch per unit effort | CPUE |
| coefficient of variation | CV |
| common test statistics | (F, t, $\chi^2$, etc.) |
| confidence interval | CI |
| correlation coefficient (multiple) | R |
| correlation coefficient (simple) | r |
| covariance | cov |
| degree (angular ) | ° |
| degrees of freedom | df |
| expected value | $E$ |
| greater than | > |
| greater than or equal to | ≥ |
| harvest per unit effort | HPUE |
| less than | < |
| less than or equal to | ≤ |
| logarithm (natural) | ln |
| logarithm (base 10) | log |
| logarithm (specify base) | $\log_2$, etc. |
| minute (angular) | ' |
| not significant | NS |
| null hypothesis | $H_O$ |
| percent | % |
| probability | P |
| probability of a type I error (rejection of the null hypothesis when true) | $\alpha$ |
| probability of a type II error (acceptance of the null hypothesis when false) | $\beta$ |
| second (angular) | " |
| standard deviation | SD |
| standard error | SE |
| variance | |
| population | Var |
| sample | var |

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# ABSTRACT

Optimal production of adult Chinook salmon *Oncorhynchus tshawytscha* from the Situk River was investigated with information from a stock assessment program (1976-2003) comprised of escapement enumeration and sampling, and harvest enumeration and sampling programs. Estimates of relative age composition from sampling of the commercial set gillnet harvest (1982-2003), the recreational fishery (1982-1983 and 1997-2003) and in the escapement (1984 and 1988-2003) were used to estimate the numbers of returning adults by age class annually. Relative age composition in years missing samples in the recreational fishery (1984-1985, 1987-1988, 1991-1996) and in the escapement (1982-1983, 1985-1987, 1994) were estimated from the gillnet samples. Spawning escapements of large fish (age-.3 and older) were the parent stock, and were estimated directly from weir counts (1976-1987) or from subtracting the estimated recreational harvest above the weir site from the weir count of large spawners (1988-2003). Measurement error in the spawning stock was zero or low in all years, with an average CV = 3%. Residuals from a fit of a linearized, log-transformed version of Ricker's exponential stock-recruit model to the data showed significant autocorrelation in process error. We corrected for this in estimating spawner-recruit parameters, and used the 1977-1994 year classes in the latter analysis. Spawning abundance that would on average produce maximum sustained yield (3,893 for age-.2 to age-.5 fish) was estimated at 730 large Chinook salmon, and the range predicted to produce 90% of MSY was estimated to be 453 to 1,052 large spawners. We recommend a range of 450 to 1,050 large spawners, with a point estimate of 730 large spawners, as the biological escapement goal range for this stock. We recommend continuation of the current stock assessment program based on biological sampling of harvests and the escapement, as well as continuation of the enumeration of the harvests and the population past the weir in the Situk River.



Key words: Chinook salmon, *Oncorhynchus tshawytscha*, Situk River, spawning abundance, age composition, escapement goal, stock-recruit analysis, maximum-sustained yield, autocorrelation.


# INTRODUCTION

Chinook salmon *Oncorhynchus tshawytscha* from the Situk River (Figure 1) are a "spring run", with adults entering the lower river in June and July. Spawning occurs between the outlet of Situk Lake and Nine Mile Bridge (on Forest Highway 10) in late August to mid-September. Juveniles rear for either a few months to just over a year in fresh water after emergence and are a combination of subyearling (age-0. or ocean-type fish) and yearling (age-1.) smolt (Kissner and Hubartt 1986; Thedinga et al. 1994). While at sea, these immature Chinook rear offshore north and west of troll, sport, and net fisheries in Southeast Alaska; then, after 1 to 5 years of ocean residence, they mature and return to the Situk River. Fish maturing at a younger age (age-.1 and -.2 fish; 1- and 2-ocean-age fish) are almost exclusively males, whereas older fish (age-.3, -.4. and -.5 fish) are a mixture of males and females. European aging notation is used throughout this manuscript, where the numeral to the left of the decimal place is the number of years spent rearing as fry in freshwater and the numeral to the right of the decimal place is the number of years of ocean residence. Total age is the sum of the two numerals plus one year for the time spent in the substrate and freshwater after egg deposition, e.g. an age-0.3 fish is 4 years old.

Age-0.3 and -0.4 Chinook salmon on average comprise about 60% of the annual spawning migration of age-.2 to -.5 (2- to 5-ocean-age) fish, although age-0.2, -1.3, -1.4 and -1.2 fish occasionally are abundant. Age-.1 fish often return in thousands of fish, but are all males, have not been enumerated consistently, and are not included in the spawner-recruit analysis in this report.

The Situk River is a relatively small drainage (176 $km^2$) that is highly productive for salmon production and includes two main forks one of which is the primary producer having two lake systems. The river supports relatively large populations of sockeye *O. nerka*, coho *O. kisutch* and pink *O. gorbuscha* salmon and steelhead *O. mykiss*, a moderate population of Chinook salmon and a small population of chum salmon *O. keta*. The run timing of sockeye and Chinook salmon in the terminal area overlap substantially yet there is little overlap of these two species with the annual pink and coho salmon runs that occur later (Figure 2).

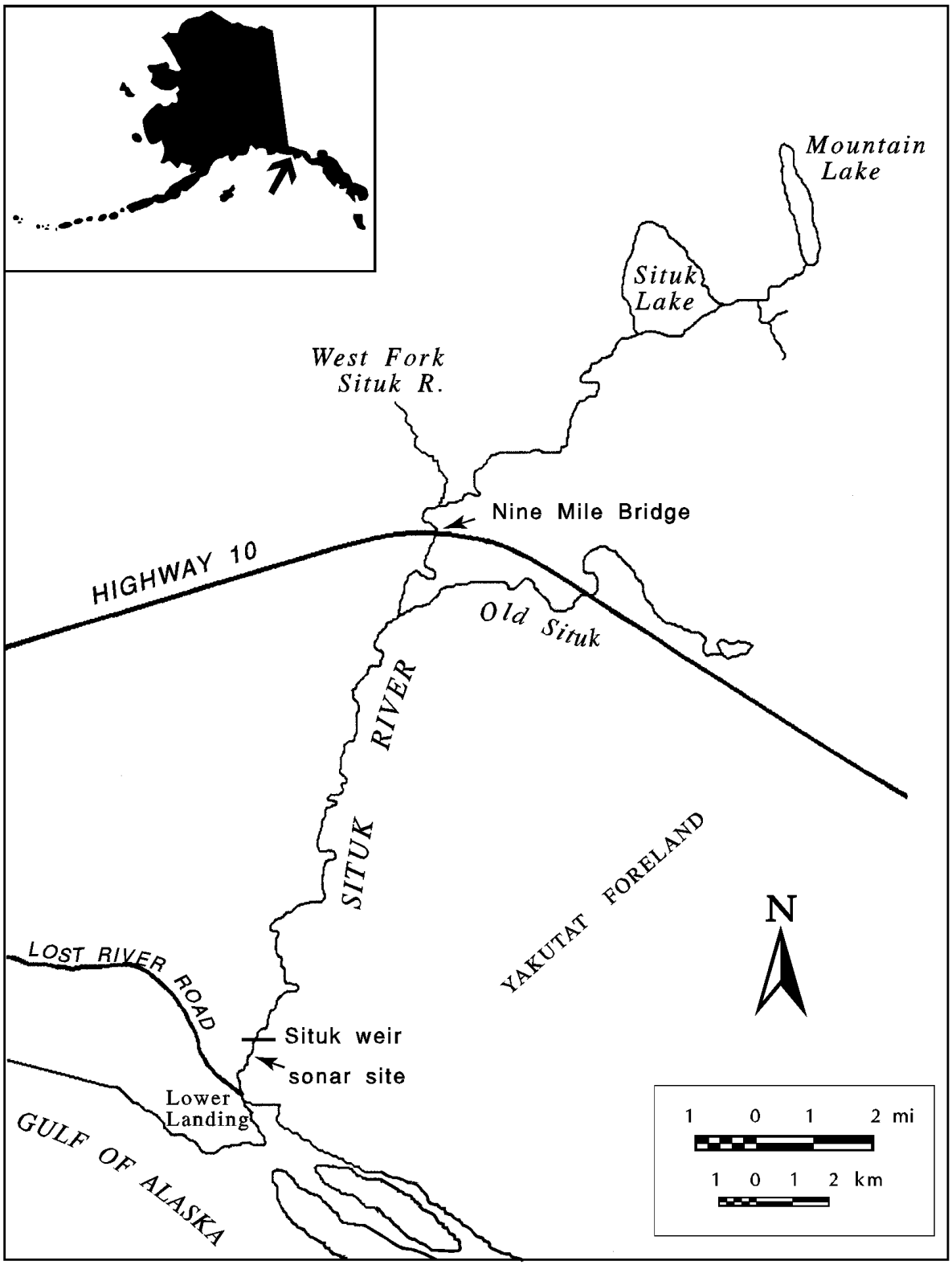


**Figure 1.–**The Situk River drainage and the upper (1976-1987; below Nine Mile Bridge) and lower (1988-2003) weir sites.

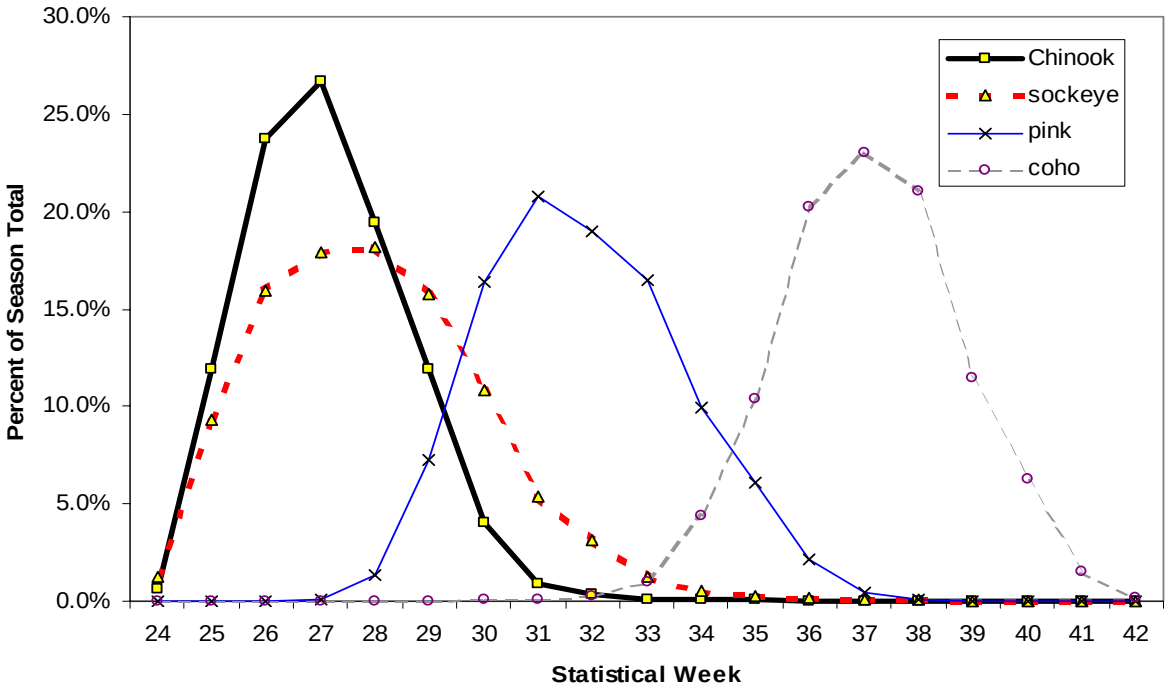


**Figure 2.–**Timing of the Situk River Chinook, sockeye, pink and coho salmon runs through the commercial set gillnet fishery in the Situk-Ahrnklin Inlet, determined from harvest statistics from 1960-2003.

Statistical week 24 begins about mid-June, on average.

Terminal runs (harvest and escapement) have averaged about 127,000 sockeye and 4,000 Chinook salmon (excluding age-.1 fish) since 1976. Commercial harvests of coho and pink salmon have averaged about 80,000 and 25,000 since 1976. Escapements of pink salmon occasionally exceed 200,000 adults. Escapements between 5,000 and 9,000 steelhead have been enumerated annually since the early 1990s. A small run of summer chum salmon is also present.

Salmon have been harvested commercially since the turn of the century in the Situk River; Situk River salmon were harvested for subsistence use before that time. Management of the commercial fisheries has focused on the sockeye and coho salmon runs. The recreational fishery harvest was relatively small prior to the 1990s.

Presently, Chinook and sockeye salmon are targeted in commercial set gillnet, sport, and subsistence/personal use fisheries. The commercial and subsistence set gillnet fishery (fishing district 182-70) takes place in the Situk-Ahrnklin Inlet where the Situk, Ahrnklin, and Lost rivers drain into the Gulf of Alaska (Figure 1). The recreational fishery predominantly takes place in the Situk River below the Forest Highway 10.

The sockeye and Chinook runs are managed to meet escapement requirements for both species. In 1991, the Alaska Board of Fisheries (ABF) adopted a management plan for the Situk River Chinook and sockeye runs (Appendix A). A weir was installed by the Alaska Department of Fish and Game (ADF&G) in 1976 to enumerate the escapement. Weir counts and harvest statistics have been used to judge run strength and shape fisheries inseason since 1976. Biological sampling for age, sex and length has occurred since 1982.

The 1991 ABF management plan includes trigger points based on a biological escapement goal for Situk River Chinook salmon, using spawner-recruit data available at that time (S. McPherson, ADF&G, Douglas, pers. comm.) That analysis recommended a point estimate of 600 large spawners. The ABF directed ADF&G to manage the Chinook stock for a range of 600 to 750 large

spawners in 1991. In 1997, ADF&G revised the Situk River escapement goal range to 500-1,000 large spawners to conform to the department's escapement goal policy and to provide a more realistic maximum sustained yield (MSY) range for management.

The purpose of our analysis is to estimate the spawning abundance of Chinook salmon in the Situk River that is associated with maximum sustained yield ($S_{MSY}$). As specified in the Pacific Salmon Treaty (PSC 1999) between Canada and the U. S. (PSC 1999: chapter 3), harvest regimes will be established that are responsive to changes in Chinook production and that are designed to meet MSY or other biologically-based escapement objectives (spawning abundance). A substantial number of years and biological sampling has both improved and extended the spawner-recruit database since the last analysis in 1991. We estimated $S_{MSY}$ with information dating back to 1977 from stock assessment and catch sampling programs on the Situk River and in the Situk-Ahrnklin Inlet.

# STATISTICS

## SITUK RIVER WEIR COUNTS

Since 1976, escapements to the Situk River have been assessed annually by counting returning adult salmon through a weir operated by ADF&G. The Situk Weir was located just below Nine Mile Bridge on Forest Highway 10 from 1976 to 1987, about 13.5 miles upstream from tidewater (Figure 1). This site was logistically advantageous, but not ideal for inseason management purposes because Chinook and sockeye salmon were several days to two weeks removed from timing in the fisheries in the Situk-Ahrnklin Inlet. For this reason the Situk Weir has been located near tidewater since 1988, about 2 km above the Lower Landing on the Lost River Road (Figure 1). Timing of weir counts at this location is one to three days removed from the Inlet fisheries.

The counts of Chinook salmon moving upstream of the weir are considered a census, without sampling error, for Chinook salmon classified in two size groups, medium- and large-sized fish. Chinook salmon classified as "large" are typically age-.3 (3-ocean-age) and older and ≥ 660 mm mid-eye to tail fork (MEF) in length (Figure 3).

Large Chinook salmon are the spawning stock used for management and stock-recruit analysis because: 1) almost all females in the Situk River are large Chinook, 2) weir counts of large Chinook are made inseason and are used to implement the management plan. Medium-sized Chinook salmon are counts of fish typically 441-659 mm MEF and age-.2 males. Medium-sized Chinook salmon in the escapement are used to determine total returns, but are not part of the escapement goal. Medium and large Chinook have been counted past the Situk Weir since 1976.

Age-.1 (1-ocean-age, or "jack") or "small" Chinook salmon about 440 mm MEF or less (~20 inches) have been partially enumerated in the Situk River escapements since 1989. The weir counts of small Chinook are incomplete in most years because spacing of pickets in the weir and trap used for biological sampling allow a portion of this size of Chinook salmon to pass uncounted and unsampled. Counts of small Chinook salmon are not included in enumerating total returns. These counts are presented in this report to document the relatively high precocity rate of the Situk River Chinook salmon population and because regulations in the recreational fishery allow for liberal harvests of small Chinook salmon.

Four adjustments were made to the weir counts of medium and large Chinook past the Situk Weir since 1976. The weir was washed out for a portion of the season in two years (1980 and 1981); the portion of the run missed in those two years was added to the weir count total (see Appendix B). In 1987 and in 1993, Chinook salmon were counted below the weir on the last day of weir operations; these counts were added to the weir count to estimate the total escapement in those two years. In 1976, 1978, 1979 and 1987 large and medium-sized Chinook salmon were counted without a breakdown by size; the number of medium and large fish was estimated for those years from the average proportions seen for 1977 and 1980-1986.

## RECREATIONAL FISHERY HARVESTS

A recreational fishery for Chinook salmon takes place annually in the Situk River. Road access to the Situk River is limited to two areas: the Lower

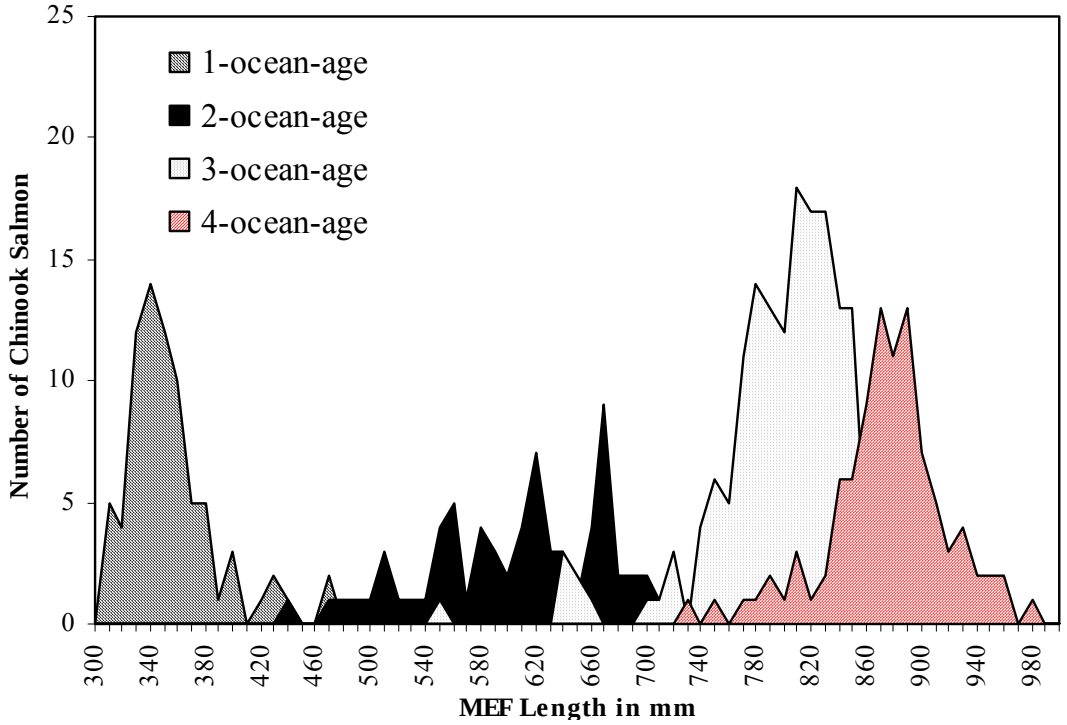


**Figure 3.–**Length-frequency polygons of ocean-age classes of Chinook salmon sampled at the weir on the Situk River in 1997**.**

*Note:* The boundary for "large" fish is ≥ 660 mm MEF.

Landing near the Situk-Ahrnklin Inlet and at Nine Mile Bridge, which is about 22 km upstream (Figure 1). Anglers fish from banks or boats after accessing the river. Some anglers float in boats from Nine Mile Bridge to the Lower Landing. Most bank fishing occurs in the lower 3 km of the river.

Sport fishing is not allowed above Nine Mile Bridge and was not allowed between Nine Mile Bridge and the upper weir site from 1976-1987. Hence, from 1976-1987 the weir counts included all Chinook salmon passing to the spawning grounds.

When the weir was moved to the lower river site in 1988, the estimated recreational harvest above the weir must be subtracted from the weir count to estimate spawning escapement. The recreational harvest of Chinook salmon in the Situk River is estimated through a statewide postal survey; this program started in 1977. The results of this program are available in published annual reports (Howe et al. 2001a). In 1996 the statewide postal survey was reconfigured to estimate harvests of salmon above and below the lower river site. In addition, an on-site creel project has been operated in recent years. We used the statewide postal survey estimates for 1977-2000 and the on-site creel estimates in 2001-2003 to estimate returns (Johnson 2005). We used the 1988-2000 postal survey estimates and the 2001-2003 creel survey estimates to estimate spawning abundance, by subtracting estimates of the recreational harvest above the weir from the weir counts.

For the period 1977-2003, the estimated recreational harvest of Chinook salmon in the Situk River has ranged from 0 (zero) large and medium-sized fish in 1986, 1989 and 1990 (fishery closed) to 1,598 large and medium-sized fish in 1997 (Appendix C). The recreational fishery harvests were 400 or fewer large and medium-sized Chinook through 1994 and then exceeded 1,000 fish annually from 1995 to 2000. Since 1988, the estimated removals in the sport

fishery above the weir have ranged from 0 (zero) in 1989 and 1990 to 812 in 1997.

## SPAWNING ABUNDANCE

For calendar years 1988 to 2003, we estimated spawning abundance by subtracting the estimated recreational harvest taken above the weir, from the weir counts or the estimated total past the weir (in years when adjustments were made to the weir counts). Details of these statistics are given in Appendix C. For 1976-1987, we consider the weir counts the annual spawning abundance of large fish $\hat{S}_{Lt}$, spawning in year *t*, and considered them known without error.

For all years (1976-2003), $\hat{S}_{Lt}$ averaged 1,473 large fish, and ranged from 434 in 1982 to 4,330 in 1995 (Table 1). This provides a contrast of 10:1 in spawning abundance. Omitting 1995, the next highest $\hat{S}_{Lt}$ of 2,067 (in 1986), provides a contrast of 4.8:1 in spawning abundance.

## COMMERCIAL AND SUBSISTENCE HARVESTS AND TOTAL RUNS

Harvests in the commercial set gillnet fishery in the Situk-Ahrnklin Inlet are reported on fish tickets and are considered a census without error. Statistics for this fishery were obtained from the Integrated Fishery Database (IFDB) reporting system as of October 16, 2003, a database maintained by ADF&G, Commercial Fisheries Division, Region 1. Harvests in the subsistence fishery in the inlet are reported on permits returned from individuals participating in this fishery. Not all permits were returned and statistics for this fishery were estimated by expanding the reported harvest for unreturned permits (usually less than 10% of the total). Estimated subsistence harvests were considered to have negligible error.

In the commercial and subsistence fisheries, fishing is usually directed at sockeye salmon, with Chinook salmon a secondary target. The gear is consistent for both fisheries, usually sockeye-mesh set gillnets are used. Commercial gillnet harvests have averaged about 1,400 Chinook since 1976, ranging from zero (1989 and 1990) to over 8,000 fish in 1995. (Table 2). Subsistence harvests have averaged 272 Chinook since 1976, ranging from about 25 fish to about 600 in recent years. Estimated total harvests of medium and large Chinook combined $\hat{H}_t$, have averaged 2,122 fish since 1976, ranging from 301 fish in 1986 to over 10,000 fish in 1995 (Table 2). Total harvests averaged about 800 Chinook salmon from 1976-1990. Since the Situk River management plan went into effect in 1991, harvests of Chinook salmon have averaged about 3,800 medium and large fish. This total does not include an average harvest of 340 age-.1 jacks since 1991.

**Table 1.–**Weir counts, sport removals and estimated large spawning Chinook salmon $\hat{S}_{Lt}$ in the Situk River, 1976-2003.

| Year | Weir count | Sport removals | $\hat{S}_{Lt}$ | (SE) |
|---|---|---|---|---|
| 1976 | 1,421 | 0 | 1,421 | (0) |
| 1977 | 1,732 | 0 | 1,732 | (0) |
| 1978 | 808 | 0 | 808 | (0) |
| 1979 | 1,284 | 0 | 1,284 | (0) |
| 1980 | 905 | 0 | 905 | (0) |
| 1981 | 702 | 0 | 702 | (0) |
| 1982 | 434 | 0 | 434 | (0) |
| 1983 | 592 | 0 | 592 | (0) |
| 1984 | 1,726 | 0 | 1,726 | (0) |
| 1985 | 1,521 | 0 | 1,521 | (0) |
| 1986 | 2,067 | 0 | 2,067 | (0) |
| 1987 | 1,379 | 0 | 1,379 | (0) |
| 1988 | 885 | 17 | 868 | (17) |
| 1989 | 637 | 0 | 637 | (0) |
| 1990 | 628 | 0 | 628 | (0) |
| 1991 | 897 | 8 | 889 | (8) |
| 1992 | 1,618 | 23 | 1,595 | (23) |
| 1993 | 980 | 28 | 952 | (28) |
| 1994 | 1,311 | 40 | 1,271 | (40) |
| 1995 | 4,700 | 370 | 4,330 | (185) |
| 1996 | 2,175 | 375 | 1,800 | (187) |
| 1997 | 2,690 | 812 | 1,878 | (197) |
| 1998 | 1,353 | 429 | 924 | (132) |
| 1999 | 1,947 | 486 | 1,461 | (152) |
| 2000 | 2,518 | 733 | 1,785 | (144) |
| 2001 | 696 | 40 | 656 | (16) |
| 2002 | 1,024 | 24 | 1,000 | (12) |
| 2003 | 2,615 | 498 | 2,117 | (68) |
| Averages | | | | |
| 1976-2003 | 1,473 | 139 | 1,334 | |
| 1976-1987 | 1,214 | 0 | 1,214 | |
| 1988-2003 | 1,667 | 243 | 1,424 | |

**Table 2.–**Estimated spawning escapements, inriver harvests, and estimated inriver harvest rates for medium and large Chinook salmon returning to the Situk River, 1976-2003.

| | Medium and Large Chinook Salmon | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Estimated escapement | | | Estimated harvest | | | | | |
| Year | Medium | Large | Total | Sport | Comm. gillnet | Subs. [a] | Total | Inriver total run | Inriver harvest rate |
| 1976 | 520 | 1,421 | 1,941 | 200 | 1,002 | 41 | 1,243 | 3,184 | 39.0% |
| 1977 | 148 | 1,732 | 1,880 | 244 | 833 | 24 | 1,101 | 2,981 | 36.9% |
| 1978 | 295 | 808 | 1,103 | 210 | 382 | 50 | 642 | 1,745 | 36.8% |
| 1979 | 470 | 1,284 | 1,754 | 282 | 1,028 | 25 | 1,335 | 3,089 | 43.2% |
| 1980 | 220 | 905 | 1,125 | 353 | 969 | 57 | 1,379 | 2,504 | 55.1% |
| 1981 | 105 | 702 | 807 | 130 | 858 | 62 | 1,050 | 1,857 | 56.5% |
| 1982 | 177 | 434 | 611 | 63 | 248 | 27 | 338 | 949 | 35.6% |
| 1983 | 257 | 592 | 849 | 42 | 349 | 50 | 441 | 1,290 | 34.2% |
| 1984 | 475 | 1,726 | 2,201 | 146 | 512 | 89 | 747 | 2,948 | 25.3% |
| 1985 | 461 | 1,521 | 1,982 | 294 | 484 | 156 | 934 | 2,916 | 32.0% |
| 1986 | 505 | 2,067 | 2,572 | 0 | 202 | 99 | 301 | 2,873 | 10.5% |
| 1987 | 505 | 1,379 | 1,884 | 75 | 891 | 24 | 990 | 2,874 | 34.4% |
| 1988 | 154 | 868 | 1,022 | 185 | 299 | 90 | 574 | 1,596 | 36.0% |
| 1989 | 243 | 637 | 880 | 0 | 1 | 496 | 497 | 1,377 | 36.1% |
| 1990 | 499 | 628 | 1,127 | 0 | 0 | 516 | 516 | 1,643 | 31.4% |
| 1991 | 114 | 889 | 1,003 | 88 | 784 | 220 | 1,092 | 2,095 | 52.1% |
| 1992 | 207 | 1,595 | 1,802 | 172 | 1,504 | 341 | 2,017 | 3,819 | 52.8% |
| 1993 | 477 | 952 | 1,429 | 137 | 790 | 202 | 1,129 | 2,558 | 44.1% |
| 1994 | 1,391 | 1,271 | 2,662 | 400 | 2,656 | 367 | 3,423 | 6,085 | 56.3% |
| 1995 | 565 | 4,330 | 4,895 | 1,407 | 8,107 | 578 | 10,092 | 14,987 | 67.3% |
| 1996 | 495 | 1,800 | 2,295 | 1,529 | 3,717 | 559 | 5,805 | 8,100 | 71.7% |
| 1997 | 434 | 1,878 | 2,312 | 1,598 | 2,339 | 352 | 4,289 | 6,601 | 65.0% |
| 1998 | 645 | 924 | 1,569 | 1,156 | 2,101 | 594 | 3,851 | 5,420 | 71.1% |
| 1999 | 189 | 1,461 | 1,650 | 1,160 | 3,810 | 588 | 5,558 | 7,208 | 77.1% |
| 2000 | 101 | 1,785 | 1,886 | 1,143 | 1,318 | 594 | 3,055 | 4,941 | 61.8% |
| 2001 | 97 | 656 | 753 | 75 | 1,087 | 402 | 1,564 | 2,317 | 67.5% |
| 2002 | 424 | 1,000 | 1,424 | 99 | 1,078 | 416 | 1,593 | 3,017 | 52.8% |
| 2003 | 299 | 2,117 | 2,416 | 909 | 2,342 | 600 | 3,851 | 6,267 | 61.4% |
| Average | 374 | 1,334 | 1,708 | 432 | 1,418 | 272 | 2,122 | 3,830 | 48.0% |

[a] Subsistence harvests include 400 fish in 1989, 415 in 1990 and 109 in 1991 taken home during commercial openings in those years with non-retention for Chinook salmon. Harvest in 2003 is preliminary.

Estimated harvest notation is "Sport" for recreational, "Comm. gillnet" for commercial set gill net and "Subs." for the subsistence fishery.

Estimated annual total runs $\hat{T}_t$ of medium and large Chinook combined are the sum of escapement and harvest in a calendar year. Total run size has increased over the time series in the data set, averaging about 2,300 for 1976-1990 and about 5,650 for 1991-2003 (Table 2).

The combined harvests represent on average an annual exploitation rate of 48% for 1976-2003. Those rates have ranged from 11% in 1986 to 77% in 1999. Annual exploitation rates have averaged about 62% since the 1991 ABF management plan was implemented.

We did not include estimates of harvest outside of those mentioned above as we do not have direct estimates of any such harvests and we conclude that they are of low magnitude and would not have any meaningful effect on our estimates of

optimal spawning. Inclusion of harvests estimates outside of the terminal runs have been explored in the past by Seibel in 1988 (M. Seibel, ADF&G, retired, pers. comm.) and McPherson in 1991 (S. McPherson, ADF&G, Douglas, unpublished data). Those analyses demonstrated that inclusion of outside harvests had negligible effect on the estimate of $S_{MSY}$.

## ESTIMATED AGE COMPOSITION

Age composition of the annual total runs was estimated from separate sampling programs for the set gillnet/subsistence fishery, the recreational fishery, and the escapement.

Estimates of age composition of Chinook salmon caught in the Situk-Ahrnklin Inlet commercial and subsistence fisheries were calculated using estimates of relative age composition from the scale sampling in the commercial fishery (see Appendix D).

In the set gillnet/subsistence fishery, the numbers of fish harvested by age and the associated variance is estimated from:

$$\hat{H}_{at} = H_t \ \hat{p}_{at}$$

$$v(\hat{H}_{at}) = H_t^2 \ v(\hat{p}_{at})$$

where $H_t$ is the harvest of adults in year $t$ and $\hat{p}_{at}$ is the estimated proportion for age group $a$ in year $t$, from scale samples taken and successfully aged.

Age composition of harvests of medium and large Chinook (combined) in the recreational fishery was estimated as the product of the estimated harvest and the relative age composition:

$$\hat{H}_{at} = \hat{H}_t \hat{p}_{at}$$

where $\hat{H}_t$ is the estimated harvest in year $t$.

Estimated variance was calculated as the product of two variates as per Goodman (1960):

$$v(\hat{H}_{at}) = v(\hat{H}_t)\hat{p}_{at}^2 + v(\hat{p}_{at})\hat{H}_t^2 - v(\hat{H}_t)v(\hat{p}_{at})$$

Estimated variances $v(\hat{H}_t)$ were calculated from the statewide harvest survey [see Howe et al. (2001a) for an example of the survey]. Estimated recreational harvests are detailed in Appendix C and estimates of age composition are detailed in Appendix D.

Estimates of age composition in the escapement were determined from our estimated escapements and associated sampling. For 1981-1987 and 1989-1990 we used the formulae for the gillnet fishery, substituting $S_t$ for $H_t$. For 1988 and 1991-2003 we use the formulae for the recreational fishery, substituting $\hat{S}_t$ for $\hat{H}_t$ , where $\hat{S}_t$ is the estimated escapement of medium $\hat{S}_{Mt}$ plus large $\hat{S}_{Lt}$ Chinook salmon.

Samples sizes, estimated abundance by age and calendar year are detailed in Appendix D for the gillnet fisheries, the recreational fisheries and the escapement. The relative age composition for the total run for each calendar year are detailed there as well, along with standard errors for the estimated number of fish by age. The estimated total runs of Chinook salmon by age for 1982-2003 are generally dominated by age-0.3 fish (total age 4) in most years (Table 3).

## PRODUCTION

Estimated production of adults from year class $y$ and its estimated variance was calculated as

$$\hat{R}_y = \sum_{i=2}^{5} \hat{S}_{1.i,y+i+2} + \sum_{i=2}^{5} \hat{S}_{0.i,y+i+1} + \sum_{i=2}^{5} \hat{H}_{1.i,y+i+2} + \sum_{i=2}^{5} \hat{H}_{0.i,y+i+1}$$

$$v(\hat{R}_y) = \sum_{i=2}^{5} v(\hat{S}_{1.i,y+i+2}) + \sum_{i=2}^{5} v(\hat{S}_{0.i,y+i+1}) + \sum_{i=2}^{5} v(\hat{H}_{1.i,y+i+2}) + \sum_{i=2}^{5} v(\hat{H}_{0.i,y+i+1})$$

where $\hat{S}_{1.i,y+i+2}$ is the estimated number of spawners age-1.$i$ (1-freshwater age, i.e., age classes 1.2, 1.3, 1.4 and 1.5) in year $y+i+2$, $\hat{S}_{0.i,y+i+1}$ is the estimated number of spawners age-0. (0-freshwater age, i.e., age classes 0.2, 0.3, 0.4 and 0.5), and the summation of both is the number of age-.2 and older spawners in the return for year class $y$. Similarly, the summation of $\hat{H}_{1.i,y+i+2}$ and $\hat{H}_{0.i,y+i+1}$ across all age classes is the estimated harvest of Chinook salmon age-.2 to age-.5 for year class $y$.

Cohort analysis using adult equivalent factors was not needed in the subsequent spawner-recruit analysis because all enumerated fish are mature in this analysis.

Estimated production by age and year class and estimates of the SEs for the age-.2-.5 and age-.3-.5 totals are shown in Table 4 for year classes 1977 through 1999. Estimated returns for the 1998 year class are incomplete, lacking age classes 0.5, 1.4 and 0.5; since these are classes comprised 3.3% of the 1987-1997 returns, we deemed this brood year to be as good as complete. The 1999 year class returns are also incomplete. We estimated the total return for the 1999 year class by dividing the return to date (through total age 4) by the average fraction complete through age 4 returns (68%) for recent (1987-1997) year classes (Table 5).

Age-0.3 fish have been the dominant age class throughout the time series and there has been shift in age of smolt (Table 5). For all year classes (1978-1997), age-0.3 fish have comprised an estimated 37% of the age-.2-.5 total returns, with age-0.4 fish accounting for 21% of the total. For more recent year classes (1987-1997), age-0.3 (45%) and age-0.4 (22%) fish have comprised an estimated 67% of total returns. For the 1978-1986 year classes, age-1. fish (progeny from yearling smolt) accounted for 42% of total returns, while later in the time series (1987-1997 year classes), the percentage of age-1. fish was substantially less (27%). Following completion of returns from the 1986 year class, only the 1990 year class (46%) produced returns with more than 25% age-1. fish.

**Table 3**.– Estimated total runs by year and age class $\hat{T}_{at}$ of Chinook salmon returning to the Situk River, 1982-2003.

| | Total age and age class | | | | | | | | | | Estimated total run | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2-yr | 3-yr | 3-yr | 4-yr | 4-yr | 5-yr | 5-yr | 6-yr | 6-yr | 7-yr | | | |
| Year | 0.1 | 0.2 | 1.1 | 0.3 | 1.2 | 0.4 | 1.3 | 0.5 | 1.4 | 1.5 | Age-.3-.5 | Age-.2-.5 | Total |
| 1982 | 0 | 156 | 0 | 346 | 92 | 138 | 61 | 0 | 144 | 12 | 701 | 949 | 949 |
| 1983 | 10 | 268 | 0 | 524 | 180 | 151 | 162 | 0 | 6 | 0 | 842 | 1,290 | 1,300 |
| 1984 | 194 | 137 | 35 | 897 | 221 | 548 | 741 | 17 | 163 | 0 | 2,367 | 2,725 | 2,953 |
| 1985 | 195 | 318 | 22 | 693 | 375 | 433 | 462 | 29 | 577 | 29 | 2,223 | 2,916 | 3,133 |
| 1986 | 33 | 324 | 4 | 556 | 417 | 417 | 602 | 0 | 556 | 0 | 2,132 | 2,873 | 2,910 |
| 1987 | 287 | 79 | 32 | 1,142 | 39 | 315 | 984 | 0 | 315 | 0 | 2,756 | 2,874 | 3,193 |
| 1988 | 0 | 35 | 0 | 118 | 172 | 747 | 88 | 0 | 439 | 0 | 1,392 | 1,599 | 1,599 |
| 1989 | 875 | 225 | 97 | 544 | 74 | 338 | 103 | 4 | 89 | 0 | 1,078 | 1,377 | 2,349 |
| 1990 | 151 | 540 | 65 | 216 | 177 | 400 | 88 | 0 | 222 | 0 | 926 | 1,643 | 1,858 |
| 1991 | 593 | 491 | 3 | 1,039 | 228 | 123 | 136 | 7 | 61 | 3 | 1,370 | 2,089 | 2,685 |
| 1992 | 119 | 544 | 36 | 841 | 147 | 1,753 | 211 | 0 | 305 | 0 | 3,110 | 3,801 | 3,956 |
| 1993 | 1,776 | 497 | 996 | 650 | 171 | 690 | 214 | 64 | 250 | 4 | 1,871 | 2,539 | 5,311 |
| 1994 | 1,576 | 2,103 | 188 | 1,525 | 841 | 1,104 | 210 | 0 | 289 | 0 | 3,128 | 6,072 | 7,836 |
| 1995 | 2,789 | 934 | 342 | 10,680 | 424 | 1,304 | 1,545 | 11 | 68 | 0 | 13,608 | 14,966 | 18,096 |
| 1996 | 1,892 | 1,071 | 207 | 3,139 | 329 | 2,375 | 714 | 34 | 427 | 0 | 6,690 | 8,090 | 10,189 |
| 1997 | 1,693 | 1,346 | 232 | 2,929 | 85 | 1,878 | 198 | 37 | 87 | 9 | 5,138 | 6,568 | 8,493 |
| 1998 | 3,185 | 1,674 | 275 | 2,633 | 111 | 822 | 71 | 0 | 29 | 0 | 3,555 | 5,340 | 8,800 |
| 1999 | 610 | 1,496 | 147 | 4,457 | 113 | 872 | 162 | 10 | 50 | 0 | 5,550 | 7,159 | 7,916 |
| 2000 | 501 | 284 | 79 | 3,584 | 120 | 557 | 345 | 0 | 50 | 0 | 4,537 | 4,941 | 5,521 |
| 2001 | 412 | 406 | 53 | 524 | 46 | 1,107 | 194 | 17 | 52 | 0 | 1,892 | 2,345 | 2,810 |
| 2002 | 262 | 1,557 | 72 | 741 | 463 | 106 | 101 | 0 | 26 | 0 | 975 | 2,995 | 3,329 |
| 2003 | 261 | 450 | 79 | 4,912 | 212 | 318 | 360 | 0 | 42 | 0 | 5,632 | 6,294 | 6,634 |

*Note:* Age-.1 fish (age classes 0.1 and 1.1) were excluded from the spawner-recruit analysis. The number of these fish is incomplete prior to 1989 and after 1998 in the above totals.

Production and return rates have been variable and measurement error has been low for both spawning escapements and total return estimates (Table 6). The average CV for spawning escapements for year classes 1977-1998 has averaged an estimated 2.4% and has increased to about 10% since the 1996 year class, as more recreational harvest has occurred above the weir. CVs for total returns of both age-.2-.5 and age-.3-.5 (large) fish have averaged about 7% over the time series. CVs for the estimated return rate $\hat{R}_{Ly} / \hat{S}_{Ly}$ have averaged about 8%. The contrast in estimated spawning escapements is 10.0:1 including the unusually large escapement in 1995 and is about half (4.8:1), excluding 1995. The contrast in age-2.-.5 returns is about 16:1, ranging from estimates of 1,035 fish for the 1984 year class to 16,420 for the 1991 year class. The contrast in age-.3-.5 (large fish) returns is 18:1, with estimates ranging from just under 800 fish for the 1984, 1986 and 1997 year classes to 13,894 fish for the 1991 year class. Estimated return rates for large fish have averaged 3.1:1 over the time series, ranging from 0.4:1 to 15.6:1.

**Table 4.–**Estimated total returns (production) by year class and age class $\hat{R}_{ay}$ of Chinook salmon returning to the Situk River, for year classes 1977-1999.

| Year Class | 0.2 | 0.3 | 1.2 | 0.4 | 1.3 | 0.5 | 1.4 | 1.5 | Age-.2-.5 | SE | Age-.3-.5 | SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1977 | 399 | 666 | 136 | 138 | 61 | 0 | 6 | 0 | 1,405 | (113) | 870 | (96) |
| 1978 | 150 | 346 | 92 | 151 | 162 | 17 | 163 | 29 | 1,110 | (117) | 868 | (84) |
| 1979 | 156 | 524 | 180 | 548 | 741 | 29 | 577 | 0 | 2,755 | (165) | 2,419 | (158) |
| 1980 | 268 | 897 | 221 | 433 | 462 | 0 | 556 | 0 | 2,838 | (207) | 2,348 | (196) |
| 1981 | 137 | 693 | 375 | 417 | 602 | 0 | 315 | 0 | 2,539 | (231) | 2,027 | (215) |
| 1982 | 318 | 556 | 417 | 315 | 984 | 0 | 439 | 0 | 3,028 | (244) | 2,294 | (204) |
| 1983 | 324 | 1,142 | 39 | 747 | 88 | 4 | 89 | 0 | 2,434 | (186) | 2,070 | (151) |
| 1984 | 79 | 118 | 172 | 338 | 103 | 0 | 222 | 3 | 1,035 | (111) | 784 | (92) |
| 1985 | 35 | 544 | 74 | 400 | 88 | 7 | 61 | 0 | 1,208 | (102) | 1,099 | (95) |
| 1986 | 225 | 216 | 177 | 123 | 136 | 0 | 305 | 4 | 1,187 | (111) | 785 | (91) |
| 1987 | 540 | 1,039 | 228 | 1,753 | 211 | 64 | 250 | 0 | 4,084 | (197) | 3,317 | (182) |
| 1988 | 491 | 841 | 147 | 690 | 214 | 0 | 289 | 0 | 2,672 | (191) | 2,034 | (173) |
| 1989 | 544 | 650 | 171 | 1,104 | 210 | 11 | 68 | 0 | 2,758 | (195) | 2,043 | (166) |
| 1990 | 497 | 1,525 | 841 | 1,304 | 1,545 | 34 | 427 | 9 | 6,182 | (302) | 4,844 | (268) |
| 1991 | 2,103 | 10,680 | 424 | 2,375 | 714 | 37 | 87 | 0 | 16,420 | (416) | 13,894 | (377) |
| 1992 | 934 | 3,139 | 329 | 1,878 | 198 | 0 | 29 | 0 | 6,506 | (254) | 5,243 | (215) |
| 1993 | 1,071 | 2,929 | 85 | 822 | 71 | 10 | 50 | 0 | 5,038 | (219) | 3,882 | (191) |
| 1994 | 1,346 | 2,633 | 111 | 872 | 162 | 0 | 50 | 0 | 5,173 | (242) | 3,717 | (216) |
| 1995 | 1,674 | 4,457 | 113 | 557 | 345 | 17 | 52 | 0 | 7,214 | (274) | 5,428 | (242) |
| 1996 | 1,496 | 3,584 | 120 | 1,107 | 194 | 0 | 26 | | 6,527 | (229) | 4,911 | (197) |
| 1997 | 284 | 524 | 46 | 106 | 101 | 0 | 42 | | 1,103 | (78) | 773 | (64) |
| 1998 [a] | 406 | 741 | 463 | 318 | 360 | | | | 2,289 | (118) | 1,419 | (102) |
| 1999 [a] | 1,557 | 4,912 | 212 | | | | | | 9,824 | | 8,055 | |
| Average | 622 | 1,795 | 214 | 770 | 352 | 11 | 195 | 2 | 3,963 | | 3,126 | |

[a] The 1998 year class was deemed complete. The estimated total return for the 1999 year class was estimated by dividing the returns through age class 1.2 by 68.0%, the average return rate through age-1.2 for the 1987-1997 year classes.

The averages shown are for the 1977-1997 year classes.

**Table 5.–**Estimated percent by year class and age class $p_{ay}$ of Chinook salmon returning to the Situk River, for year classes 1978-1997.

| Year Class | 0.2 | 0.3 | 1.2 | 0.4 | 1.3 | 0.5 | 1.4 | 1.5 | Age-0. | Age-1. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1978 | 13.5% | 31.2% | 8.3% | 13.6% | 14.6% | 1.6% | 14.7% | 2.6% | 59.8% | 40.2% |
| 1979 | 5.7% | 19.0% | 6.5% | 19.9% | 26.9% | 1.0% | 21.0% | 0.0% | 45.6% | 54.4% |
| 1980 | 9.5% | 31.6% | 7.8% | 15.3% | 16.3% | 0.0% | 19.6% | 0.0% | 56.3% | 43.7% |
| 1981 | 5.4% | 27.3% | 14.8% | 16.4% | 23.7% | 0.0% | 12.4% | 0.0% | 49.1% | 50.9% |
| 1982 | 10.5% | 18.4% | 13.8% | 10.4% | 32.5% | 0.0% | 14.5% | 0.0% | 39.2% | 60.8% |
| 1983 | 13.3% | 46.9% | 1.6% | 30.7% | 3.6% | 0.2% | 3.7% | 0.0% | 91.1% | 8.9% |
| 1984 | 7.6% | 11.4% | 16.6% | 32.6% | 10.0% | 0.0% | 21.5% | 0.3% | 51.7% | 48.3% |
| 1985 | 2.9% | 45.0% | 6.2% | 33.1% | 7.3% | 0.5% | 5.0% | 0.0% | 81.6% | 18.4% |
| 1986 | 18.9% | 18.2% | 14.9% | 10.4% | 11.5% | 0.0% | 25.7% | 0.3% | 47.5% | 52.5% |
| 1987 | 13.2% | 25.4% | 5.6% | 42.9% | 5.2% | 1.6% | 6.1% | 0.0% | 83.1% | 16.9% |
| 1988 | 18.4% | 31.5% | 5.5% | 25.8% | 8.0% | 0.0% | 10.8% | 0.0% | 75.7% | 24.3% |
| 1989 | 19.7% | 23.6% | 6.2% | 40.0% | 7.6% | 0.4% | 2.5% | 0.0% | 83.7% | 16.3% |
| 1990 | 8.0% | 24.7% | 13.6% | 21.1% | 25.0% | 0.6% | 6.9% | 0.1% | 54.3% | 45.7% |
| 1991 | 12.8% | 65.0% | 2.6% | 14.5% | 4.3% | 0.2% | 0.5% | 0.0% | 92.5% | 7.5% |
| 1992 | 14.4% | 48.2% | 5.1% | 28.9% | 3.0% | 0.0% | 0.4% | 0.0% | 91.5% | 8.5% |
| 1993 | 21.3% | 58.1% | 1.7% | 16.3% | 1.4% | 0.2% | 1.0% | 0.0% | 95.9% | 4.1% |
| 1994 | 26.0% | 50.9% | 2.1% | 16.9% | 3.1% | 0.0% | 1.0% | 0.0% | 93.8% | 6.2% |
| 1995 | 23.2% | 61.8% | 1.6% | 7.7% | 4.8% | 0.2% | 0.7% | 0.0% | 92.9% | 7.1% |
| 1996 | 22.9% | 54.9% | 1.8% | 17.0% | 3.0% | 0.0% | 0.4% | 0.0% | 94.8% | 5.2% |
| 1997 | 25.7% | 47.5% | 4.2% | 9.6% | 9.2% | 0.0% | 3.8% | 0.0% | 82.8% | 17.2% |
| Average | 18.7% | 44.7% | 4.5% | 21.9% | 6.8% | 0.3% | 3.1% | <0.1% | | |
| Cum. | 18.7% | 63.4% | 67.9% | 89.8% | 96.6% | 96.9% | 100.0% | 100.0% | | |

*Note:* The averages shown are for the 1987-1997 year classes.

# ANALYSIS

## PARAMETER ESTIMATES

Logarithms of returns per spawner were first regressed against spawners using the following formulation:

$$\ln(R_y/S_y) = \ln(\alpha) - \beta S_y + \varepsilon_y$$

where ln ($\alpha$) and $\beta$ are parameters and $\varepsilon_y$ is an independent set of residuals ~ Norm(0, $\sigma^2$). Information for the 1995 brood year was excluded from this analysis because: 1) we do not believe the 1995 year class to be indicative of the productivity of the Situk River Chinook salmon stock, on average, at that level of spawners, 2) it is more than double any other escapement and influences parameter estimates much more than any other individual year class, and 3) the fit of the model, with corrections for autocorrelation, was substantially improved without the 1995 year class (corrected $R^2$ = 0.69 vs. 0.50). Investigation of residuals from this fit showed that the $\varepsilon_y$ were not independent, but were serially correlated as per an autoregressive process of lag one brood year (Figure 4). From Noakes et al. 1987), the appropriate model under this circumstance is

$$\ln(R_y/S_y) =$$

$$(1-\phi)\ln\alpha + \phi\ln(R_{y-1}/S_{y-1}) - \beta S_y + \phi\beta S_{y-1} + u_y$$

where $\phi$ is the autoregressive parameter ($0 \le \phi < 1$ for salmon) and $u_y$ ~ Norm(0, $\sigma^2$). Because the brood year 1995 was so near the end of the time series, and because escapements in 1996-1998 were typical of years before 1995, information in Table 6 was truncated after 1994 for this next regression. Parameters were estimated with ML procedures in the computer statistical program SYSTAT© and the results given in Table 7. Note that the log of the estimate of the parameter $\ln(\hat{\alpha})$ is given in Table 4 when

**Table 6.–**Estimated production $\hat{R}_y$ by year class, the estimated abundance of their parents $\hat{S}_{Ly}$ (age-.3 and older) and the return per spawner ( $\hat{R}_{Ly} / \hat{S}_{Ly}$ ; both in large fish) for the population of Chinook salmon spawning in the Situk River.

| Year class y | $\hat{S}_{Ly}$ | SE($\hat{S}_{Ly}$) | CV($\hat{S}_{Ly}$) | $\hat{R}_y$ | SE($\hat{R}_y$) | CV($\hat{R}_y$) | $\hat{R}_{Ly} / \hat{S}_{Ly}$ | SE($\hat{R}_{Ly} / \hat{S}_{Ly}$) |
|---|---|---|---|---|---|---|---|---|
| 1977 | 1,732 | (0) | 0.0% | 1,405 | (113) | 8.1% | 0.50 | 0.06 |
| 1978 | 808 | (0) | 0.0% | 1,110 | (117) | 10.6% | 1.07 | 0.10 |
| 1979 | 1,284 | (0) | 0.0% | 2,755 | (165) | 6.0% | 1.88 | 0.12 |
| 1980 | 905 | (0) | 0.0% | 2,838 | (207) | 7.3% | 2.59 | 0.22 |
| 1981 | 702 | (0) | 0.0% | 2,539 | (231) | 9.1% | 2.89 | 0.31 |
| 1982 | 434 | (0) | 0.0% | 3,028 | (244) | 8.1% | 5.29 | 0.47 |
| 1983 | 592 | (0) | 0.0% | 2,434 | (186) | 7.6% | 3.50 | 0.25 |
| 1984 | 1,726 | (0) | 0.0% | 1,035 | (111) | 10.7% | 0.45 | 0.05 |
| 1985 | 1,521 | (0) | 0.0% | 1,208 | (102) | 8.5% | 0.72 | 0.06 |
| 1986 | 2,067 | (0) | 0.0% | 1,187 | (111) | 9.4% | 0.38 | 0.04 |
| 1987 | 1,379 | (0) | 0.0% | 4,084 | (197) | 4.8% | 2.41 | 0.13 |
| 1988 | 868 | (17) | 1.9% | 2,672 | (191) | 7.1% | 2.34 | 0.20 |
| 1989 | 637 | (0) | 0.0% | 2,758 | (195) | 7.1% | 3.21 | 0.26 |
| 1990 | 628 | (0) | 0.0% | 6,182 | (302) | 4.9% | 7.71 | 0.43 |
| 1991 | 889 | (8) | 0.9% | 16,420 | (416) | 2.5% | 15.63 | 0.45 |
| 1992 | 1,595 | (23) | 1.5% | 6,506 | (254) | 3.9% | 3.29 | 0.14 |
| 1993 | 952 | (28) | 2.9% | 5,038 | (219) | 4.3% | 4.08 | 0.23 |
| 1994 | 1,271 | (40) | 3.1% | 5,173 | (242) | 4.7% | 2.92 | 0.19 |
| 1995 | 4,330 | (185) | 4.3% | 7,214 | (274) | 3.8% | 1.25 | 0.08 |
| 1996 | 1,800 | (187) | 10.4% | 6,527 | (229) | 3.5% | 2.73 | 0.30 |
| 1997 | 1,878 | (197) | 10.5% | 1,103 | (78) | 7.1% | 0.41 | 0.05 |
| 1998 | 924 | (132) | 14.3% | 2,289 | (118) | 5.2% | 1.54 | 0.25 |
| 1999 | 1,461 | (152) | 10.4% | *9,824* | | | 3.36 | |

(Standard error in parentheses; coefficient of variation (CV) in percent.)

the parameter estimated in the regression is ln $\alpha$. The relationship between these two expressions is derived and given in Appendix E. Inspection of residuals from this fit indicates that residuals are stationary and represent random variation (Figure 5).

An estimate of $S_{MSY}$ (= 730 large salmon) was obtained by iteratively solving the equation:

$$1 = (1 - \hat{\beta}\hat{S}_{MSY}) \exp(\ln \hat{\alpha})(1+\tau)^{-1} \exp(-\hat{\beta}\hat{S}_{MSY})$$

where $\tau$ = the expected ratio of medium to large salmon in the spawning population (see eq. 1.14 in CTC 1999). From Table 2, fractions of medium-sized salmon averaged 19% across years making $\tau$ = 0.23 [= 0.19/(1-.19)]. Ninety percent of MSY in medium and large salmon combined can be expected at escapements between 453 and 1,052 large salmon. The production relationship is shown in Figure 6.

## DISCUSSION

Our estimate of spawning abundance of Chinook salmon in the Situk River that on average will produce MSY is relatively unbiased. Measurement error in estimates of spawning abundance, if ignored when estimating parameters, will make a salmon population appear more productive than it is (Hilborn and Walters 1992:288). We had little or no measurement error in the estimates of spawning abundance. The CVs for our estimates of recruits

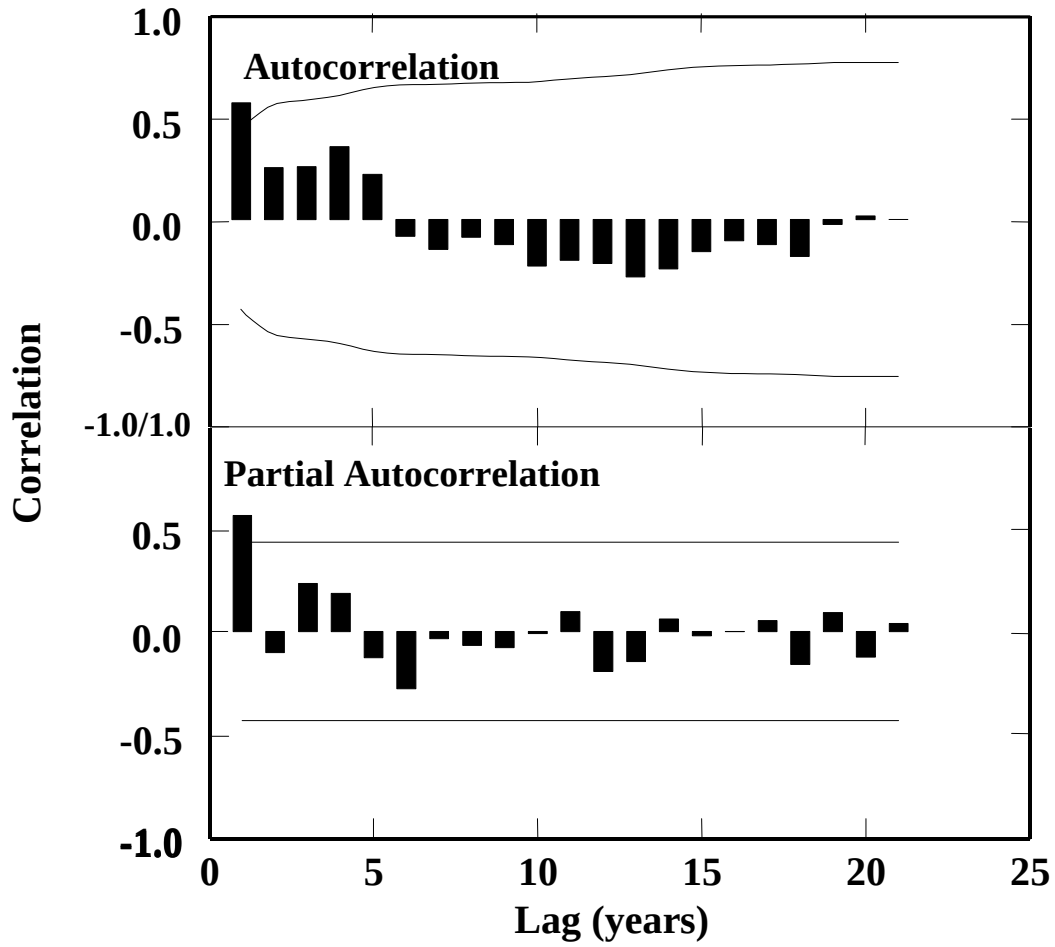


**Figure 4.–**Autocorrelation and partial autocorrelation functions for residuals from the fitted stock-recruit relationship for Situk River Chinook salmon for brood years 1977 through 1997 with 1995 excluded.

Quadratic interpolation was used to bridge the series for the missing brood year. Thin lines correspond to significance levels corresponding to a Type I error of 5%. An autoregressive process of lag one brood year is indicated.

(total returns) were low, averaging 6.9% for the 1977-1994 year classes. However, we did have autocorrelation present in the spawner-recruit relationship and our estimate of 730 large Chinook salmon was based on parameters corrected for any bias due to autocorrelation.

In correcting for the bias in spawner-recruit parameters, we excluded the 1995 year class from the analysis. This single year doubled the contrast in spawning escapements to 10:1, compared to 4.8:1 for the 1977-1994 year classes. We excluded the 1995 year class (with an escapement of 4,330) because it is the only estimated spawning escapement above 2,067 fish in the time series. Also this year class was unexpectedly productive and significantly more influential on the spawner-recruit relationship than any other year class (see Appendix F for details). It produced an estimated total return above replacement (R:S = 1.25, Table 6). Most brood years with escapements greater than 1,500 large spawners did not replace themselves. Five of the eight broods with escapements greater than 1,500 large spawners yielded R:S rates of less than 0.72 (range 0.41 to 0.72).

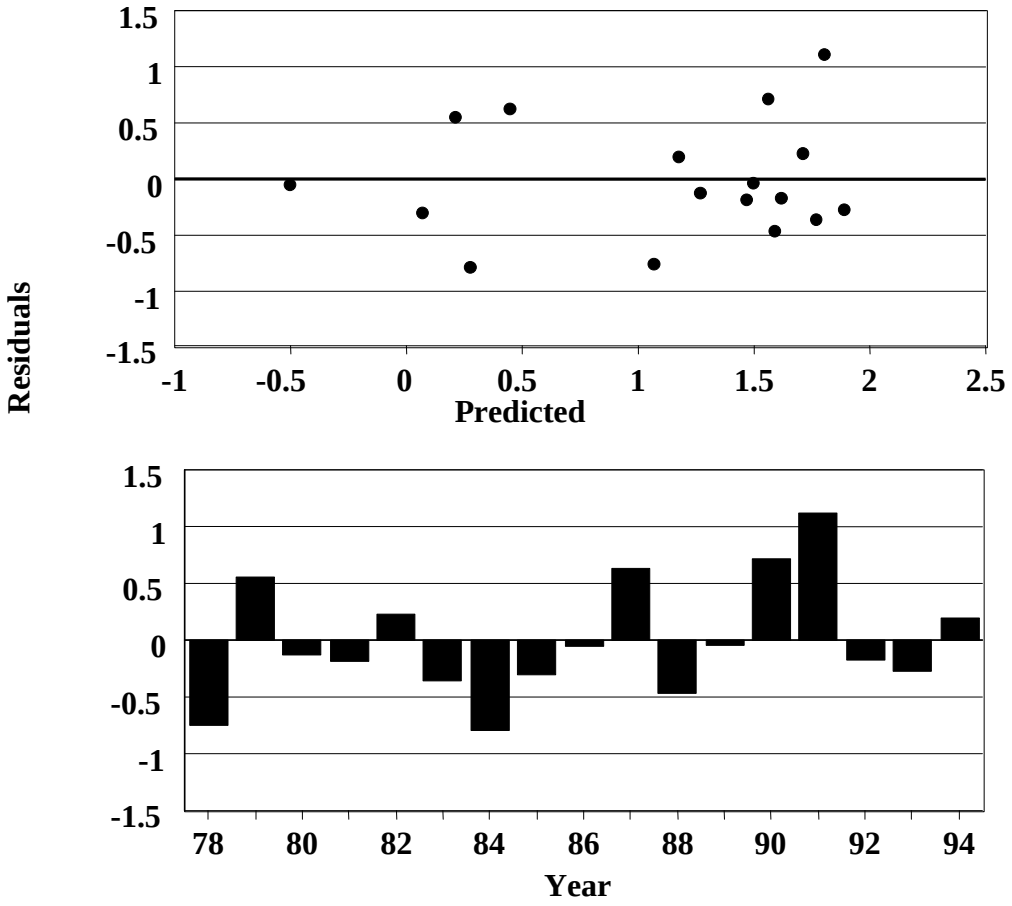


**Figure 5.–**Residuals from the fitted stock-recruit model with an autoregressive parameter with lag one year plotted against predicted values and against brood years for Chinook salmon of the Situk River.

The three year classes with escapements greater than 1,500 large spawners and R:S rates greater than 1.0 were all embedded in the 1990-1996 year classes, which were more productive than the year classes before and after this period. The escapements of 1,595 (1992), 4,330 (1995), and 1,800 (1996) produced R:S rates of 3.29, 1.25 and 2.73, an average of 2.61, less than half the average R:S rates for the seven year classes from 1990-1996 of 5.42 (Table 6).

The 1995 year class escapement of 4,330 was a result of the very high returns from the 1991 brood. It is common to see one extremely productive year class, which may be 4-5 times the average year-class production in spawner-recruit data sets with 20-30 years of data. We have seen such phenomena in other SEAK/TBR Chinook salmon stocks, such as the Taku River (McPherson et al. 2000), the Stikine River (Bernard et al. 2000), the Chilkat River (Ericksen and McPherson 2004) and the Unuk River (Weller and McPherson 2003).

If an annual run of 16,000 or more occurs in the future, such as that produced by the 1991 year class, it is likely that a large escapement will occur again. Fishery management (Appendix A) and the associated fishing effort, is unlikely to exert a harvest rate above 75%. This will populate the spawner-recruit database with other large escapements to provide a contrast in return rates at relatively large escapement levels.

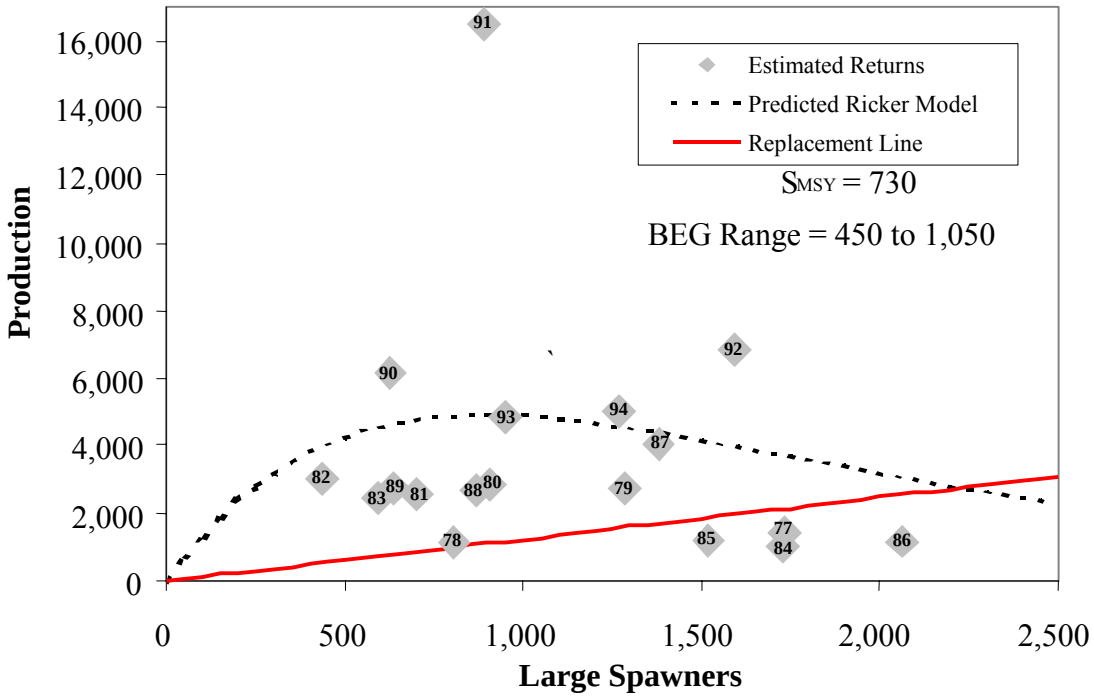


**Figure 6.–**Estimated production of age-.2-.5 Chinook salmon in year classes 1977–1994 against the estimated spawning abundance of their parents age-.3 and older for the population in the Situk River**.**

It is unknown whether these shifts in year-class strength arose from environmental factors in the fresh or saltwater environments. Regardless, this variation in production is a strong argument that the stock-production relationship should include a variable representing survival rates. Unfortunately, no data concerning survival rates for this stock of Chinook salmon, or any nearby stocks, are available.

## CONCLUSIONS AND RECOMMENDATIONS

***Sampling to estimate age composition of harvests and escapements should continue.*** The recreational and gillnet fisheries along with the escapement should all be sampled with enough intensity to provide estimates with precision on par or better than historical statistics. Knowledge of catch and escapement by age is essential to estimating production by year class, and subsequently to our understanding of the stock-production relationship for Chinook salmon in the Situk River.

***The productivity of the stock of Chinook salmon spawning in the Situk River changed over the duration of this time series.*** The total returns of

**Table 7.–**Estimates of parameters for the stock-recruit model along with estimates of their variances for Chinook salmon in the Situk River based on brood years 1977 through 1994.

| Parameter | Estimate |
|---|---|
| $\ln(\hat{\alpha})$ | 2.484 (P = 0.0001) |
| $v[\ln(\hat{\alpha})]$ | 0.2587 |
| $\hat{\alpha}$ | 11.993 |
| $\hat{\beta}$ | 0.0011135 (P = 0.0011) |
| $v[\hat{\beta}]$ | $8.9 \times 10^{-8}$ |
| $\hat{\phi}$ | 0.65 (P = 0.0030) |
| $v[\hat{\phi}]$ | 0.0407 |
| $R^2$ | 0.88 |
| $R^2$ (corrected) | 0.69 |

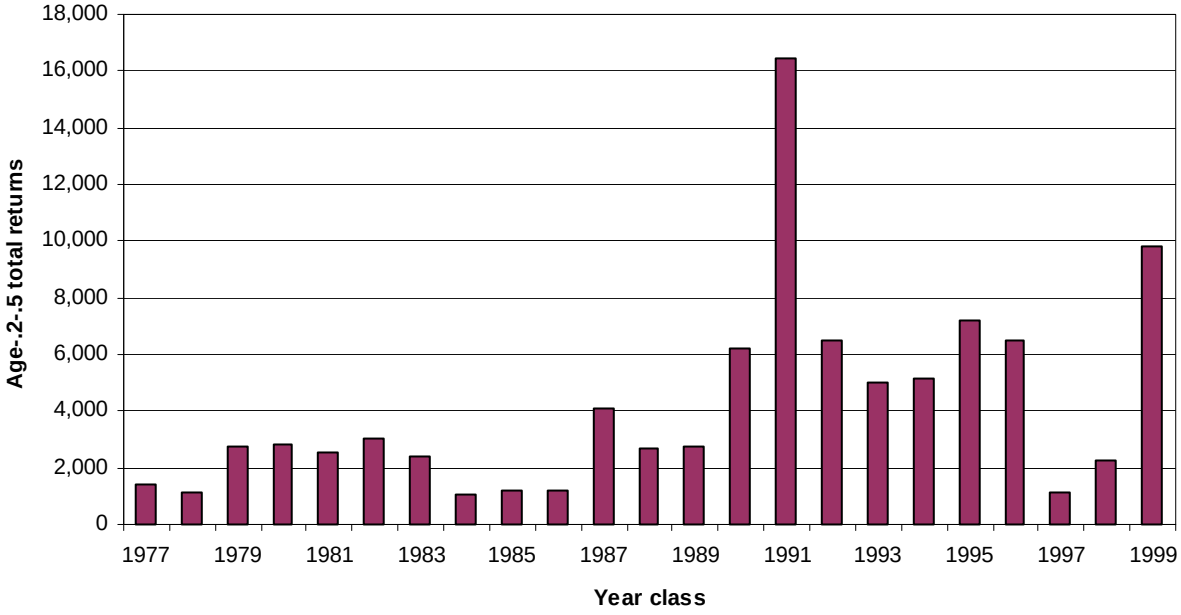


**Figure 7.–**Estimated production of age-.2-.5 Chinook salmon in year classes 1977–1999.

age-.2-.5 fish from the 1990-1996 year classes was 3.4 times the average before this period. Total returns averaged 2,235 for the 1977-1989 broods, compared to 7,676 for the 1990-1996 broods (Figure 7). Since then, the 1997 and 1998 returns were comparable to the earlier period, while the 1999 brood is similar to the returns seen in the more productive period.

***An escapement goal range of 450 to 1,050 adult spawners (3-5 ocean-age) is recommended for Chinook salmon spawning in the Situk River.*** The limits of this range are the approximate values that will produce 90% of the predicted MSY at $S_{MSY}$. An internal review committee of ADF&G accepted this range early in 2003 as the revised escapement goal and range for this stock, with a point estimate of 730 large spawners. The Alaska Board of Fisheries accepted this goal in 2003.

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# APPENDIX A:
# SITUK-AHRNKLIN INLET AND LOST RIVER CHINOOK SALMON FISHERY MANAGEMENT PLAN

**Appendix A1.–**5 AAC 30.365. Situk-Ahrnklin Inlet and Lost River Chinook Salmon Fishery Management Plan

(a) The inriver escapement goal for the Situk River Chinook salmon stock is 600 large fish (three ocean age and older) with a range of 450 to 750 fish.

(b) Before the department makes a projection for Chinook salmon escapement to the Situk River weir,

(1) the Situk River sport fishery is restricted to non-retention of Chinook salmon;

(2) the commercial troll fishery in state waters between Loran lines 7960-Y-30390 and 7960-Y-30200 is closed; and

(3) the Situk-Ahrnklin Inlet and Lost River commercial set gillnet fisheries are restricted to non-sale of Chinook salmon.

(c) The department shall manage the commercial set gillnet fishery in the Situk-Ahrnklin Inlet and Lost River, the commercial troll fishery off Yakutat, and the sport Chinook salmon fishery in the Situk River before July 15 as follows:

(1) if the projected escapement of Chinook salmon to the Situk River weir is less than 350 Chinook (three ocean age and older) the department shall close the Situk River Chinook sport fishery, the subsistence, personal use, and commercial set gillnet fisheries, and the commercial troll fishery in state waters between Loran lines 7960-Y-30390 and 7960-Y-30200;

(2) if the projected escapement of Chinook salmon to the Situk River weir is 350 - 450 fish (three ocean age and older), the department shall

(A) adopt emergency orders that do one or more of the following:

(i) establish a "non-sale" Chinook salmon season in the Situk-Ahrnklin Inlet and Lost River set gillnet fisheries;

(ii) close the commercial troll fishery in state waters between Loran lines 7960-Y-30390 and 7960-Y-30200;

(iii) restrict the weekly fishing periods in the Situk-Ahrnklin Inlet and Lost River set gillnet fisheries; and

(B) close the sport fishery for Chinook salmon in the Situk River;

(3) if the projected escapement of Chinook salmon to the Situk River weir is 451 - 750 fish (three ocean age and older), the department shall

(A) adopt emergency orders that do one or more of the following:

(i) establish a "non-sale" Chinook salmon season in the Situk-Ahrnklin Inlet and Lost River set gillnet fisheries;

(ii) close the commercial troll fishery in state waters between Loran lines 7960-Y-30390 and 7960-Y-30200;

(iii) restrict the weekly fishing periods in the Situk-Ahrnklin Inlet and Lost River set gillnet fisheries; and

(B) restrict the sport harvest of Chinook salmon in the Situk River by emergency orders that do one or more of the following:

-continued-

(i) close portions of the river to Chinook salmon sport fishing;

(ii) allow the use of only unbaited, artificial lures;

(iii) allow only catch and release sport fishing for Chinook salmon over 20 inches;

(4) if the projected escapement of Chinook salmon to the Situk River weir is greater than 750 fish (three ocean age and older), the department shall

(A) manage the commercial set gillnet fisheries in the Situk-Ahrnklin Inlet and Lost River based on sockeye salmon run strength; and

(B) provide a sport fishery for Chinook salmon in which the bag limit is one Chinook salmon over 20 inches in length and the seasonal limit from June 1 through August 31 is two Chinook salmon over 20 inches in length; if a Chinook salmon sport fishery is established under this paragraph, each angler shall immediately record the angler's catch on a Situk River Chinook salmon catch record.

# APPENDIX B: WEIR COUNTS OF CHINOOK SALMON IN THE SITUK RIVER , 1976-2002

**Appendix B1.–**Weir counts of Chinook salmon in the Situk River, 1976-2002.

Daily counts of Chinook salmon past the weir in the Situk River from 1976 to 2002 are documented in this appendix. Complete counts of large and medium Chinook salmon (>440 mm MEF) are given and incomplete counts of small Chinook salmon (<440 mm MEF or almost all age-.1 fish) are included.

The Situk River weir was located at the upper river site from 1976 to1987, just below Nine Mile Bride (Figure 1). From 1976 to 1979 the weir was constructed with chicken wire to block the passage of salmon upstream until weir technicians opened the weir trap to count them. From 1980 to 1987 the weir was constructed with vertical pickets to hold salmon until counted. Counts of Chinook salmon at the Nine Mile Bridge location consisted of counts of large Chinook (Appendix B1), medium Chinook (Appendix B2) and large and medium Chinook salmon combined (Appendix B3). No small Chinook salmon were recorded at the Nine Mile Bridge location.

Counts at the upper (Nine Mile Bridge) location were adjusted for inconsistencies as follows. Large and medium Chinook salmon counts through the Situk River weir were not segregated in 1976, 1978, 1979 and 1987. In those four years, we estimated the number of large spawning Chinook from the average proportion of large fish counted in 1977 and 1980-1986, multiplied by the weir count of large and medium Chinook combined. In 1980 and 1981, weir counts were incomplete due to weir outages. In 1980, a total of 432 Chinook salmon were added to the weir count, 348 large and 84 medium-sized fish. In 1981, a total of 123 Chinook salmon were added to the weir count, 107 large and 16 medium-sized fish.

The Situk River weir was located at the lower river site near tidewater from 1988 to present, with data presented through 2001. The weir at the lower river site has been constructed with pickets since 1988. However, from 1988 to 1994, it was designed with anchored pickets; whereas in 1995, it was reconfigured as a floating picket weir.

Large Chinook (Appendix B4) have been counted separately from medium Chinook (Appendix B5) each year since 1988, or all years at the lower river site. Small Chinook (Appendix B6) have been counted at the lower river site since 1989. Small, medium and large Chinook have been counted separately at the lower river site since 1990; combined counts for all Chinook are included in Appendix B7. Note that the numbers of small Chinook are incomplete counts because picket spacing in the weir and the sampling trap allow a portion of these small fish to slip through uncounted. In 1993, 109 large Chinook salmon were counted below the weir on the last day of weir operations and were added to weir counts;

**Appendix Table B1**.–Comparison of the percent of medium and large Chinook salmon from segregation in visual weir counts vs. members sampled and aged. Count below refers to seasonal tallies of the percentage breakdown of medium and large fish by weir technicians, whereas Sample refers to percent of aged samples that were age-.2 (medium) vs. age-.3 to -.5 (large).

| Year | Source | Medium | Large | Difference |
|---|---|---|---|---|
| 1990 | Count | 44.3% | 55.7% | 1.0% |
| | Sample | 43.3% | 56.7% | |
| 1991 | Count | 12.8% | 87.2% | 30.2% |
| | Sample | 43.1% | 56.9% | |
| 1992 | Count | 12.7% | 87.3% | 0.7% |
| | Sample | 12.0% | 88.0% | |
| 1993 | Count | 33.3% | 66.7% | 7.0% |
| | Sample | 26.3% | 73.7% | |
| 1994 | Count | 52.9% | 47.1% | |
| | Sample | NS | NS | |
| 1995 | Count | 11.6% | 88.4% | 0.6% |
| | Sample | 11.0% | 89.0% | |
| 1996 | Count | 21.7% | 78.3% | 4.0% |
| | Sample | 17.6% | 82.4% | |
| 1997 | Count | 17.8% | 82.2% | 3.5% |
| | Sample | 21.3% | 78.7% | |
| 1998 | Count | 38.6% | 61.4% | 7.8% |
| | Sample | 30.8% | 69.2% | |
| 1999 | Count | 13.4% | 86.6% | 1.6% |
| | Sample | 15.0% | 85.0% | |
| 2000 | Count | 6.0% | 94.0% | 1.4% |
| | Sample | 4.6% | 95.4% | |
| 2001 | Count | 12.8% | 87.2% | 10.6% |
| | Sample | 23.4% | 76.6% | |

weir counts were not adjusted in any other year at the lower river site.

As mentioned in the body of this report, the estimated escapement of large Chinook salmon is used as the spawning stock for both management and spawner-recruit analysis (ADF&G *Unpublished*). This is a standard used by ADF&G for all wild Chinook stocks in the region of Southeast Alaska and Yakutat, including the transboundary stocks that originate in Canada—the Taku, Stikine and Alsek Rivers. Large Chinook are used as the standard because: 1) large Chinook salmon contain the vast majority of all females for all stocks and 2) they can be estimated with greater accuracy than age-.1 and age-.2 fish, in most systems.

In the Situk River, each annual run is managed to achieve escapements of large Chinook and sockeye salmon, with management actions for Chinook salmon specified in the management plan in Appendix A. Preseason forecasts are used prior to inseason information to project annual run size and to set management early in the season. Subsequently, weir counts of large Chinook salmon are provided to managers daily during the fishing season. Management is then refined dependent upon where the projection of the total escapement lies in relationship to the trigger points in the management plan. Consequently, good management is tied to our ability to accurately count large Chinook salmon at the weir, and distinguish them from medium and small Chinook salmon.

We compared the percentage of medium and large fish counted by weir technicians to the percentage of medium (age-.2) and large (age-.3 to -.5) Chinook sampled in the weir trap from 1990-2001 (Appendix B8), except in 1994 when Chinook salmon were not sampled at the weir for age structure. The 11-year comparison reveals that weir counts are representative of the large spawners passing the weir. The average difference in percents counted versus sampled was 6.2% over 11 years. In seven years the difference was <5%. By far the largest difference occurred in 1991, when the weir counts were 30% higher in relative numbers of large Chinook.

**Appendix B2 .–**Daily weir counts of large (≥28" TL) Chinook salmon past the Situk River weir, located below Nine Mile Bridge, 1976-1987.[a, b, c]

| | Year | | | | | | | | | | | | | Cum. | Cum. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | Avg | avg | prop. |
| 31-May | | | | | 0 | | 0 | | | | | | 0 | 0 | 0.000 |
| 01-Jun | | | | | 0 | | 0 | | | | | | 0 | 0 | 0.000 |
| 02-Jun | | | | | 0 | | 0 | | | | | | 0 | 0 | 0.000 |
| 03-Jun | | | | | 0 | | 0 | | | | | | 0 | 0 | 0.000 |
| 04-Jun | | | | | 0 | | 0 | | | | 0 | | 0 | 0 | 0.000 |
| 05-Jun | | | | | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0.000 |
| 06-Jun | | | | | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0.000 |
| 07-Jun | | 0 | | | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0.000 |
| 08-Jun | | 0 | | | 0 | 0 | 0 | | 2 | | 0 | | 0 | 0 | 0.000 |
| 09-Jun | | 0 | | | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0.000 |
| 10-Jun | | 0 | | | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0.000 |
| 11-Jun | | 0 | | | 0 | 0 | 0 | | 0 | | 2 | | 0 | 1 | 0.000 |
| 12-Jun | | 0 | | | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | 1 | 0.000 |
| 13-Jun | | 0 | | | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | 1 | 0.000 |
| 14-Jun | | 1 | | | 0 | 0 | 0 | 0 | 0 | | 1 | | 0 | 1 | 0.001 |
| 15-Jun | | 2 | | | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | 1 | 0.001 |
| 16-Jun | | 5 | | | 0 | 1 | 0 | 0 | 0 | | 0 | | 1 | 2 | 0.002 |
| 17-Jun | | 2 | | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | 0 | 2 | 0.002 |
| 18-Jun | | 0 | | | 0 | 5 | 1 | 0 | 0 | 0 | 0 | | 1 | 3 | 0.002 |
| 19-Jun | | 8 | | | 0 | 1 | 0 | 0 | 0 | 0 | 0 | | 1 | 4 | 0.003 |
| 20-Jun | | 11 | | | 0 | 3 | 0 | 0 | 0 | 0 | 1 | | 2 | 6 | 0.005 |
| 21-Jun | | 4 | | | 0 | 1 | 0 | 0 | 5 | 0 | 0 | | 1 | 7 | 0.006 |
| 22-Jun | | 2 | | | 0 | 2 | 1 | 0 | 0 | 0 | 0 | | 1 | 8 | 0.007 |
| 23-Jun | | 4 | | | 1 | 1 | 0 | 2 | 2 | 0 | 0 | | 1 | 9 | 0.008 |
| 24-Jun | | 18 | | | 11 | 0 | 0 | 19 | 1 | 1 | 0 | | 6 | 15 | 0.013 |
| 25-Jun | | 5 | | | 2 | 1 | 0 | 0 | 0 | 3 | 0 | | 1 | 17 | 0.014 |
| 26-Jun | | 45 | | | 9 | 0 | 0 | 1 | 0 | 0 | 0 | | 7 | 24 | 0.020 |
| 27-Jun | | 25 | | | 10 | 0 | 2 | 1 | 11 | 4 | 4 | | 7 | 31 | 0.027 |
| 28-Jun | | 14 | | | 4 | 2 | 0 | 0 | 1 | 0 | 6 | | 3 | 34 | 0.029 |
| 29-Jun | | 10 | | | 1 | 3 | 6 | 1 | 21 | 9 | 8 | | 7 | 41 | 0.036 |
| 30-Jun | | 34 | | | 0 | 31 | 2 | 7 | 3 | 23 | 3 | | 13 | 54 | 0.047 |
| 01-Jul | | 25 | | | 2 | 11 | 1 | 0 | 1 | 18 | 29 | | 11 | 65 | 0.056 |
| 02-Jul | | 21 | | | 2 | | 5 | 2 | 0 | 1 | 13 | | 6 | 71 | 0.061 |
| 03-Jul | | 60 | | | 11 | | 9 | 1 | 22 | 3 | 2 | | 14 | 84 | 0.073 |
| 04-Jul | | 53 | | | 2 | | 0 | 1 | 29 | 31 | 9 | | 16 | 100 | 0.087 |
| 05-Jul | | 2 | | | 6 | | 4 | 5 | 7 | 39 | 4 | | 8 | 108 | 0.094 |
| 06-Jul | | 36 | | | 7 | | 1 | 5 | 6 | 16 | 3 | | 9 | 117 | 0.102 |
| 07-Jul | | 11 | | | 9 | 0 | 4 | 2 | 11 | 11 | 2 | | 6 | 124 | 0.107 |
| 08-Jul | | 24 | | | 4 | 3 | 3 | 0 | 3 | 9 | 7 | | 7 | 130 | 0.113 |
| 09-Jul | | 74 | | | 2 | 0 | 0 | 0 | 254 | 12 | 0 | | 43 | 173 | 0.150 |
| 10-Jul | | 15 | | | 2 | 23 | 0 | 0 | 21 | 9 | 31 | | 13 | 186 | 0.161 |
| 11-Jul | | 120 | | | 5 | 42 | 4 | 1 | 33 | 20 | 3 | | 29 | 214 | 0.186 |
| 12-Jul | | 15 | | | 11 | 9 | 3 | 2 | 1 | 2 | 29 | | 9 | 223 | 0.194 |
| 13-Jul | | 11 | | | 11 | 19 | 11 | 3 | 15 | 27 | 20 | | 15 | 238 | 0.206 |
| 14-Jul | | 7 | | | 9 | 10 | 0 | 3 | 12 | 1 | 31 | | 9 | 247 | 0.214 |
| 15-Jul | | 41 | | | 6 | 10 | 2 | 3 | 1 | 50 | 12 | | 16 | 263 | 0.228 |
| 16-Jul | | 27 | | | 5 | 4 | 4 | 2 | 6 | 29 | 2 | | 10 | 272 | 0.236 |
| 17-Jul | | 27 | | | 1 | 11 | 1 | 1 | 17 | 5 | 2 | | 8 | 281 | 0.243 |
| 18-Jul | | 132 | | | 0 | 3 | 1 | 3 | 13 | 43 | 17 | | 27 | 307 | 0.266 |
| 19-Jul | | 18 | | | 1 | 4 | 7 | 2 | 2 | 24 | 3 | | 8 | 315 | 0.273 |
| 20-Jul | | 7 | | | 37 | 42 | 2 | 16 | 32 | 77 | 47 | | 33 | 347 | 0.301 |
| 21-Jul | | 7 | | | 23 | 36 | 2 | 6 | 18 | 0 | 13 | | 13 | 360 | 0.312 |
| 22-Jul | | 0 | | | 5 | 5 | 10 | 77 | 5 | 39 | 18 | | 20 | 380 | 0.330 |
| 23-Jul | | 55 | | | 34 | 36 | 3 | 2 | 11 | 11 | 27 | | 22 | 403 | 0.349 |
| 24-Jul | | 8 | | | 7 | 8 | 0 | 2 | 55 | 30 | 76 | | 23 | 426 | 0.369 |
| 25-Jul | | 46 | | | 5 | 4 | 0 | 41 | 50 | 32 | 101 | | 35 | 461 | 0.400 |
| 26-Jul | | 83 | | | 1 | 11 | 10 | 8 | 21 | 13 | 195 | | 43 | 503 | 0.437 |
| 27-Jul | | 52 | | | 25 | 12 | 14 | 3 | 18 | 17 | 53 | | 24 | 528 | 0.458 |
| 28-Jul | | 53 | | | 147 | 4 | 15 | 16 | 95 | 39 | 54 | | 53 | 581 | 0.503 |
| 29-Jul | | 101 | | | 139 | 12 | 0 | 9 | 51 | 14 | 40 | | 46 | 626 | 0.543 |
| 30-Jul | | 23 | | | | 13 | 5 | 1 | 52 | 56 | 20 | | 21 | 648 | 0.562 |
| 31-Jul | | 24 | | | | 9 | 5 | 8 | 29 | 54 | 97 | | 28 | 676 | 0.586 |

-continued-

**Appendix B2.**–Page 2 of 2**.**

| Date | Year | | | | | | | | | | | | Avg | Cum. avg | Cum. prop. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | | | |
| 01-Aug | | 7 | | | | 6 | 1 | 4 | 126 | 11 | 116 | | 34 | 710 | 0.615 |
| 02-Aug | | 3 | | | | 21 | 4 | 13 | 9 | 58 | 11 | | 15 | 725 | 0.628 |
| 03-Aug | | 6 | | | | 18 | 13 | 35 | 34 | 8 | 58 | | 22 | 746 | 0.647 |
| 04-Aug | | 8 | | | | 4 | 0 | 4 | 114 | 33 | 211 | | 47 | 793 | 0.688 |
| 05-Aug | | 44 | | | | 2 | 0 | 3 | 37 | 119 | 38 | | 30 | 823 | 0.714 |
| 06-Aug | | 48 | | | | 112 | 0 | 91 | 74 | 159 | 22 | | 63 | 886 | 0.769 |
| 07-Aug | | 6 | | | | 9 | 0 | 11 | 20 | 29 | 80 | | 19 | 906 | 0.786 |
| 08-Aug | | 23 | | | | 10 | 100 | 15 | 23 | 32 | 53 | | 32 | 938 | 0.813 |
| 09-Aug | | 13 | | | | | 28 | 58 | 155 | 58 | 73 | | 48 | 986 | 0.855 |
| 10-Aug | | 80 | | | | | 6 | 31 | 20 | 18 | 151 | | 38 | 1,024 | 0.888 |
| 11-Aug | | 80 | | | | | 4 | 27 | 156 | 22 | 13 | | 38 | 1,062 | 0.921 |
| 12-Aug | | 9 | | | | 3 | 1 | 10 | 9 | 54 | 82 | | 21 | 1,083 | 0.939 |
| 13-Aug | | 1 | | | | 7 | 20 | 3 | 4 | 104 | 52 | | 24 | 1,107 | 0.960 |
| 14-Aug | | 20 | | | | 11 | 1 | 12 | 0 | 13 | 30 | | 11 | 1,118 | 0.969 |
| 15-Aug | | 3 | | | | | 9 | 12 | 0 | 26 | 34 | | 11 | 1,128 | 0.978 |
| 16-Aug | | 3 | | | | | 7 | 3 | 2 | 5 | 51 | | 9 | 1,137 | 0.986 |
| 17-Aug | | 10 | | | | | 7 | 4 | 3 | | 6 | | 4 | 1,141 | 0.989 |
| 18-Aug | | | | | | | 10 | 0 | 3 | | | | 2 | 1,142 | 0.991 |
| 19-Aug | | | | | | | 10 | | | | | | 1 | 1,144 | 0.992 |
| 20-Aug | | | | | | | 11 | | | | | | 1 | 1,145 | 0.993 |
| 21-Aug | | | | | | | 14 | | | | | | 2 | 1,147 | 0.995 |
| 22-Aug | | | | | | | 12 | | | | | | 2 | 1,148 | 0.996 |
| 23-Aug | | | | | | | 22 | | | | | | 3 | 1,151 | 0.998 |
| 24-Aug | | | | | | | 16 | | | | | | 2 | 1,153 | 1.000 |
| Weir total | | 1,732 | | | 557 | 595 | 434 | 592 | 1,726 | 1,521 | 2,067 | | 1,153 | | |
| Add-on number | | | | | 348 | 107 | | | | | | 85 | | | |
| Estimated total | 1,421 | 1,732 | 808 | 1,284 | 905 | 702 | 434 | 592 | 1,726 | 1,521 | 2,067 | 1,379 | 1,195 | | |

[a] Weir counts in 1976, 1977, 1978 and 1987 were combined counts of large and medium-sized Chinook salmon. The number of large Chinook was estimated from the average proportion of large Chinook in 1977 and 1980-1986. No small (age-.1 fish were counted at the Nine Mile Bridge location.

[b] In 1980 and 1981, 348 and 107 large Chinook were added to weir counts to account for weir outages.

[c] In 1987, 85 large Chinook were counted below the weir on the day it was removed, and were added to the estimated weir count of large Chinook salmon.

**Appendix B3.–** Daily weir counts of medium (20-28" TL) Chinook salmon past the Situk River weir, located below Nine Mile Bridge, 1976-1987. [a, b]

| | Year | | | | | | | | | | | | | Cum. | Cum. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | Avg | avg | prop. |
| 31-May | | | | | 0 | | 0 | | | | | | 0 | 0 | 0.000 |
| 01-Jun | | | | | 0 | | 0 | | | | | | 0 | 0 | 0.000 |
| 02-Jun | | | | | 0 | | 0 | | | | | | 0 | 0 | 0.000 |
| 03-Jun | | | | | 0 | | 0 | | | | | | 0 | 0 | 0.000 |
| 04-Jun | | | | | 0 | | 0 | | | | 0 | | 0 | 0 | 0.000 |
| 05-Jun | | | | | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0.000 |
| 06-Jun | | | | | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0.000 |
| 07-Jun | | 0 | | | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0.000 |
| 08-Jun | | 0 | | | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0.000 |
| 09-Jun | | 0 | | | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0.000 |
| 10-Jun | | 0 | | | 0 | 0 | 0 | | 0 | | 1 | | 0 | 0 | 0.000 |
| 11-Jun | | 0 | | | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0.000 |
| 12-Jun | | 0 | | | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | 0 | 0.000 |
| 13-Jun | | 0 | | | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | 0 | 0.000 |
| 14-Jun | | 0 | | | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | 0 | 0.000 |
| 15-Jun | | 1 | | | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | 0 | 0.001 |
| 16-Jun | | 2 | | | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | 1 | 0.002 |
| 17-Jun | | 0 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 1 | 0.002 |
| 18-Jun | | 1 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 1 | 0.002 |
| 19-Jun | | 2 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 1 | 0.003 |
| 20-Jun | | 0 | | | 0 | 1 | 0 | 0 | 0 | 0 | 0 | | 0 | 1 | 0.004 |
| 21-Jun | | 1 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 1 | 0.004 |
| 22-Jun | | 1 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 1 | 0.004 |
| 23-Jun | | 0 | | | 0 | 0 | 0 | 1 | 2 | 0 | 0 | | 0 | 2 | 0.006 |
| 24-Jun | | 2 | | | 4 | 0 | 0 | 5 | 0 | 0 | 0 | | 1 | 3 | 0.011 |
| 25-Jun | | 5 | | | 1 | 1 | 0 | 0 | 0 | 0 | 0 | | 1 | 4 | 0.014 |
| 26-Jun | | 0 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 4 | 0.014 |
| 27-Jun | | 1 | | | 0 | 0 | 0 | 1 | 1 | 0 | 0 | | 0 | 4 | 0.015 |
| 28-Jun | | 2 | | | 5 | 0 | 0 | 3 | 0 | 0 | 0 | | 1 | 6 | 0.020 |
| 29-Jun | | 0 | | | 1 | 0 | 1 | 0 | 2 | 0 | 3 | | 1 | 6 | 0.023 |
| 30-Jun | | 1 | | | 0 | 3 | 1 | 1 | 0 | 0 | 8 | | 2 | 8 | 0.029 |
| 01-Jul | | 1 | | | 1 | 0 | 0 | 0 | 0 | 0 | 8 | | 1 | 9 | 0.033 |
| 02-Jul | | 0 | | | 1 | | 1 | 0 | 0 | 0 | 2 | | 1 | 10 | 0.035 |
| 03-Jul | | 6 | | | 1 | | 1 | 2 | 3 | 0 | 0 | | 2 | 12 | 0.041 |
| 04-Jul | | 4 | | | 1 | | 0 | 1 | 1 | 27 | 0 | | 4 | 16 | 0.056 |
| 05-Jul | | 0 | | | 2 | | 4 | 3 | 0 | 0 | 1 | | 1 | 17 | 0.060 |
| 06-Jul | | 0 | | | 4 | | 0 | 0 | 3 | 1 | 1 | | 1 | 18 | 0.065 |
| 07-Jul | | 0 | | | 2 | 0 | 3 | 0 | 2 | 0 | 0 | | 1 | 19 | 0.068 |
| 08-Jul | | 2 | | | 0 | 0 | 3 | 0 | 0 | 4 | 0 | | 1 | 20 | 0.072 |
| 09-Jul | | 4 | | | 0 | 0 | 4 | 0 | 17 | 2 | 3 | | 4 | 24 | 0.085 |
| 10-Jul | | 2 | | | 0 | 4 | 3 | 3 | 1 | 5 | 2 | | 3 | 26 | 0.094 |
| 11-Jul | | 7 | | | 0 | 2 | 5 | 1 | 1 | 9 | 1 | | 3 | 30 | 0.105 |
| 12-Jul | | 6 | | | 0 | 5 | 7 | 0 | 0 | 4 | 1 | | 3 | 33 | 0.116 |
| 13-Jul | | 6 | | | 2 | 2 | 7 | 0 | 0 | 5 | 3 | | 3 | 36 | 0.127 |
| 14-Jul | | 1 | | | 6 | 2 | 2 | 2 | 1 | 0 | 5 | | 2 | 38 | 0.135 |
| 15-Jul | | 5 | | | 2 | 0 | 2 | 2 | 1 | 14 | 4 | | 4 | 42 | 0.149 |
| 16-Jul | | 4 | | | 4 | 1 | 2 | 6 | 2 | 8 | 5 | | 4 | 46 | 0.163 |
| 17-Jul | | 2 | | | 1 | 2 | 0 | 1 | 3 | 15 | 3 | | 3 | 49 | 0.175 |
| 18-Jul | | 8 | | | 0 | 1 | 4 | 3 | 1 | 8 | 8 | | 4 | 53 | 0.190 |
| 19-Jul | | 4 | | | 0 | 0 | 6 | 2 | 3 | 6 | 0 | | 3 | 56 | 0.199 |
| 20-Jul | | 0 | | | 15 | 5 | 1 | 8 | 2 | 6 | 19 | | 7 | 63 | 0.224 |
| 21-Jul | | 6 | | | 10 | 3 | 5 | 2 | 7 | 0 | 11 | | 6 | 68 | 0.243 |
| 22-Jul | | 0 | | | 7 | 0 | 6 | 20 | 0 | 13 | 7 | | 7 | 75 | 0.267 |
| 23-Jul | | 3 | | | 8 | 6 | 5 | 0 | 6 | 10 | 12 | | 6 | 81 | 0.289 |
| 24-Jul | | 9 | | | 2 | 3 | 5 | 3 | 6 | 27 | 21 | | 10 | 91 | 0.323 |
| 25-Jul | | 2 | | | 1 | 2 | 0 | 13 | 26 | 30 | 32 | | 13 | 104 | 0.370 |
| 26-Jul | | 8 | | | 4 | 2 | 9 | 6 | 2 | 5 | 54 | | 11 | 115 | 0.410 |
| 27-Jul | | 1 | | | 1 | 1 | 8 | 10 | 18 | 9 | 38 | | 11 | 126 | 0.448 |
| 28-Jul | | 4 | | | 30 | 3 | 7 | 13 | 18 | 9 | 10 | | 12 | 138 | 0.490 |
| 29-Jul | | 9 | | | 20 | 2 | 0 | 3 | 25 | 22 | 7 | | 11 | 149 | 0.529 |
| 30-Jul | | 1 | | | | 7 | 1 | 1 | 18 | 17 | 12 | | 7 | 156 | 0.555 |
| 31-Jul | | 0 | | | | 4 | 5 | 4 | 27 | 10 | 13 | | 8 | 164 | 0.583 |

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**Appendix B3. –**Page 2 of 2.

| | Year | | | | | | | | | | | | | Cum. | Cum. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | Avg | avg | prop. |
| 01-Aug | | 1 | | | | 0 | 1 | 3 | 5 | 9 | 11 | | 4 | 168 | 0.596 |
| 02-Aug | | 0 | | | | 3 | 2 | 2 | 14 | 13 | 6 | | 5 | 173 | 0.614 |
| 03-Aug | | 1 | | | | 4 | 4 | 18 | 17 | 2 | 17 | | 8 | 180 | 0.642 |
| 04-Aug | | 0 | | | | 3 | 1 | 7 | 69 | 24 | 45 | | 19 | 199 | 0.708 |
| 05-Aug | | 3 | | | | 0 | 0 | 6 | 26 | 32 | 1 | | 9 | 208 | 0.738 |
| 06-Aug | | 3 | | | | 6 | 3 | 52 | 39 | 53 | 15 | | 21 | 229 | 0.815 |
| 07-Aug | | 1 | | | | 6 | 0 | 7 | 14 | 6 | 22 | | 7 | 236 | 0.839 |
| 08-Aug | | 2 | | | | 1 | 21 | 5 | 11 | 9 | 12 | | 8 | 244 | 0.867 |
| 09-Aug | | 2 | | | | | 3 | 17 | 38 | 5 | 9 | | 9 | 253 | 0.899 |
| 10-Aug | | 2 | | | | | 0 | 6 | 17 | 6 | 20 | | 6 | 259 | 0.922 |
| 11-Aug | | 4 | | | | | 0 | 3 | 8 | 6 | 5 | | 3 | 262 | 0.934 |
| 12-Aug | | 2 | | | | 0 | 0 | 3 | 1 | 8 | 11 | | 3 | 266 | 0.945 |
| 13-Aug | | 0 | | | | 3 | 9 | 2 | 5 | 9 | 21 | | 6 | 272 | 0.967 |
| 14-Aug | | 2 | | | | 1 | 0 | 3 | 4 | 4 | 11 | | 3 | 275 | 0.978 |
| 15-Aug | | 0 | | | | | 6 | 2 | 6 | 8 | 3 | | 3 | 278 | 0.989 |
| 16-Aug | | 0 | | | | | 5 | 0 | 2 | 1 | 1 | | 1 | 279 | 0.993 |
| 17-Aug | | 1 | | | | | 2 | 1 | 0 | | 0 | | 1 | 280 | 0.995 |
| 18-Aug | | | | | | | 3 | 0 | 0 | | | | 0 | 280 | 0.996 |
| 19-Aug | | | | | | | 1 | | | | | | 0 | 280 | 0.996 |
| 20-Aug | | | | | | | 1 | | | | | | 0 | 280 | 0.997 |
| 21-Aug | | | | | | | 1 | | | | | | 0 | 280 | 0.997 |
| 22-Aug | | | | | | | 4 | | | | | | 1 | 281 | 0.999 |
| 23-Aug | | | | | | | 1 | | | | | | 0 | 281 | 1.000 |
| 24-Aug | | | | | | | 1 | | | | | | 0 | 281 | 1.000 |
| Weir total | | 148 | | | 136 | 89 | 177 | 257 | 475 | 461 | 505 | | 281 | | |
| Add-on number | | | | | 84 | 16 | | | | | | | | | |
| Estimated total | 520 | 148 | 295 | 470 | 220 | 105 | 177 | 257 | 475 | 461 | 505 | 505 | 329 | | |

[a] Weir counts in 1976, 1977, 1978 and 1987 were combined counts of large and medium-sized Chinook salmon. The number of large Chinook was estimated from the average proportion of medium Chinook in 1977 and 1980-1986. No small (age-.1 fish were counted at the Nine Mile Bridge location.

[b] In 1980 and 1981, 84 and 16 medium Chinook were added to weir counts to account for weir outages.

**Appendix B4.–** Daily weir counts of large and medium Chinook salmon past the Situk River weir, located below Nine Mile Bridge, 1976-1987. [a, b, c]

| | Year | | | | | | | | | | | | | Cum. | Cum. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | Avg | avg | prop. |
| 31-May | | | | 0 | 0 | | 0 | | | | | | 0 | 0 | 0.000 |
| 01-Jun | | | | 0 | 0 | | 0 | | | | | | 0 | 0 | 0.000 |
| 02-Jun | | | | 0 | 0 | | 0 | | | | | | 0 | 0 | 0.000 |
| 03-Jun | | | | 0 | 0 | | 0 | | | | | | 0 | 0 | 0.000 |
| 04-Jun | | | | 0 | 0 | | 0 | | | | 0 | | 0 | 0 | 0.000 |
| 05-Jun | | | | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0.000 |
| 06-Jun | | | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0.000 |
| 07-Jun | | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0.000 |
| 08-Jun | | 0 | 0 | 0 | 0 | 0 | 0 | | 2 | | 0 | | 0 | 0 | 0.000 |
| 09-Jun | | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0.000 |
| 10-Jun | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | 1 | | 0 | 0 | 0.000 |
| 11-Jun | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | 2 | 0 | 0 | 0 | 0.000 |
| 12-Jun | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0.000 |
| 13-Jun | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0.000 |
| 14-Jun | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 1 | 0 | 0 | 1 | 0.000 |
| 15-Jun | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 1 | 0.001 |
| 16-Jun | 0 | 7 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | 0 | 0 | 1 | 2 | 0.001 |
| 17-Jun | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 0.001 |
| 18-Jun | 7 | 1 | 0 | 0 | 0 | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 0.002 |
| 19-Jun | 0 | 10 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 0.003 |
| 20-Jun | 4 | 11 | 1 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 6 | 0.004 |
| 21-Jun | 0 | 5 | 2 | 0 | 0 | 1 | 0 | 0 | 5 | 0 | 0 | 0 | 1 | 7 | 0.004 |
| 22-Jun | 2 | 3 | 1 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 8 | 0.005 |
| 23-Jun | 1 | 4 | 8 | 2 | 1 | 1 | 0 | 3 | 4 | 0 | 0 | 0 | 2 | 10 | 0.006 |
| 24-Jun | 3 | 20 | 1 | 0 | 15 | 0 | 0 | 24 | 1 | 1 | 0 | 0 | 5 | 15 | 0.010 |
| 25-Jun | 3 | 10 | 3 | 0 | 3 | 2 | 0 | 0 | 0 | 3 | 0 | 1 | 2 | 17 | 0.011 |
| 26-Jun | 0 | 45 | 13 | 3 | 9 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 6 | 23 | 0.015 |
| 27-Jun | 3 | 26 | 9 | 4 | 10 | 0 | 2 | 2 | 12 | 4 | 4 | 0 | 6 | 30 | 0.020 |
| 28-Jun | 7 | 16 | 4 | 15 | 9 | 2 | 0 | 3 | 1 | 0 | 6 | 0 | 5 | 35 | 0.023 |
| 29-Jun | 10 | 10 | 4 | 1 | 2 | 3 | 7 | 1 | 23 | 9 | 11 | 3 | 7 | 42 | 0.028 |
| 30-Jun | 6 | 35 | 2 | 2 | 0 | 34 | 3 | 8 | 3 | 23 | 11 | 9 | 11 | 53 | 0.035 |
| 01-Jul | 12 | 26 | 5 | 1 | 3 | 11 | 1 | 0 | 1 | 18 | 37 | 25 | 12 | 65 | 0.043 |
| 02-Jul | 6 | 21 | 23 | 28 | 3 | | 6 | 2 | 0 | 1 | 15 | 0 | 9 | 74 | 0.049 |
| 03-Jul | 6 | 66 | 19 | 75 | 12 | | 10 | 3 | 25 | 3 | 2 | 4 | 19 | 92 | 0.061 |
| 04-Jul | 13 | 57 | 17 | 64 | 3 | | 0 | 2 | 30 | 58 | 9 | 0 | 21 | 113 | 0.075 |
| 05-Jul | 59 | 2 | 10 | 18 | 8 | | 8 | 8 | 7 | 39 | 5 | 3 | 14 | 127 | 0.085 |
| 06-Jul | 74 | 36 | 12 | 20 | 11 | | 1 | 5 | 9 | 17 | 4 | 5 | 16 | 143 | 0.095 |
| 07-Jul | 82 | 11 | 22 | 6 | 11 | 0 | 7 | 2 | 13 | 11 | 2 | 3 | 14 | 158 | 0.105 |
| 08-Jul | 54 | 26 | 15 | 6 | 4 | 3 | 6 | 0 | 3 | 13 | 7 | 15 | 13 | 170 | 0.113 |
| 09-Jul | 11 | 78 | 7 | 4 | 2 | 0 | 4 | 0 | 271 | 14 | 3 | 8 | 34 | 204 | 0.135 |
| 10-Jul | 17 | 17 | 28 | 12 | 2 | 27 | 3 | 3 | 22 | 14 | 33 | 3 | 15 | 219 | 0.145 |
| 11-Jul | 34 | 127 | 21 | 4 | 5 | 44 | 9 | 2 | 34 | 29 | 4 | 19 | 28 | 247 | 0.164 |
| 12-Jul | 66 | 21 | 7 | 5 | 11 | 14 | 10 | 2 | 1 | 6 | 30 | 20 | 16 | 263 | 0.174 |
| 13-Jul | 33 | 17 | 19 | 0 | 13 | 21 | 18 | 3 | 15 | 32 | 23 | 0 | 16 | 279 | 0.185 |
| 14-Jul | 21 | 8 | 5 | 7 | 15 | 12 | 2 | 5 | 13 | 1 | 36 | 0 | 10 | 289 | 0.192 |
| 15-Jul | 107 | 46 | 3 | 16 | 8 | 10 | 4 | 5 | 2 | 64 | 16 | 0 | 23 | 313 | 0.208 |
| 16-Jul | 38 | 31 | 36 | 4 | 9 | 5 | 6 | 8 | 8 | 37 | 7 | 10 | 17 | 329 | 0.219 |
| 17-Jul | 8 | 29 | 25 | 34 | 2 | 13 | 1 | 2 | 20 | 20 | 5 | 0 | 13 | 342 | 0.227 |
| 18-Jul | 15 | 140 | 26 | 54 | 0 | 4 | 5 | 6 | 14 | 51 | 25 | 8 | 29 | 371 | 0.247 |
| 19-Jul | 97 | 22 | 18 | 37 | 1 | 4 | 13 | 4 | 5 | 30 | 3 | 4 | 20 | 391 | 0.260 |
| 20-Jul | 103 | 7 | 24 | 31 | 52 | 47 | 3 | 24 | 34 | 83 | 66 | 25 | 42 | 433 | 0.287 |
| 21-Jul | 75 | 13 | 15 | 11 | 33 | 39 | 7 | 8 | 25 | 0 | 24 | 10 | 22 | 455 | 0.302 |
| 22-Jul | 7 | 0 | 10 | 9 | 12 | 5 | 16 | 97 | 5 | 52 | 25 | 19 | 21 | 476 | 0.316 |
| 23-Jul | 10 | 58 | 46 | 7 | 42 | 42 | 8 | 2 | 17 | 21 | 39 | 41 | 28 | 504 | 0.334 |
| 24-Jul | 25 | 17 | 11 | 12 | 9 | 11 | 5 | 5 | 61 | 57 | 97 | 39 | 29 | 533 | 0.354 |
| 25-Jul | 38 | 48 | 44 | 87 | 6 | 6 | 0 | 54 | 76 | 62 | 133 | 7 | 47 | 580 | 0.385 |
| 26-Jul | 139 | 91 | 17 | 76 | 5 | 13 | 19 | 14 | 23 | 18 | 249 | 20 | 57 | 637 | 0.423 |
| 27-Jul | 67 | 53 | 9 | 11 | 26 | 13 | 22 | 13 | 36 | 26 | 91 | 94 | 38 | 675 | 0.448 |
| 28-Jul | 18 | 57 | 23 | 62 | 177 | 7 | 22 | 29 | 113 | 48 | 64 | 41 | 55 | 730 | 0.485 |
| 29-Jul | 68 | 110 | 3 | 101 | 159 | 14 | 0 | 12 | 76 | 36 | 47 | 81 | 59 | 789 | 0.524 |
| 30-Jul | 70 | 24 | 26 | 89 | | 20 | 6 | 2 | 70 | 73 | 32 | 33 | 37 | 826 | 0.549 |
| 31-Jul | 28 | 24 | 21 | 8 | | 13 | 10 | 12 | 56 | 64 | 110 | 41 | 32 | 858 | 0.570 |

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**Appendix B4. –**Page 2 of 2.

| | Year | | | | | | | | | | | | | Cum. | Cum. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | Avg | avg | prop. |
| 01-Aug | 48 | 8 | 13 | 7 | | 6 | 2 | 7 | 131 | 20 | 127 | 95 | 39 | 897 | 0.596 |
| 02-Aug | 80 | 3 | 60 | 5 | | 24 | 6 | 15 | 23 | 71 | 17 | 22 | 27 | 924 | 0.614 |
| 03-Aug | 37 | 7 | 48 | 13 | | 22 | 17 | 53 | 51 | 10 | 75 | 74 | 34 | 958 | 0.636 |
| 04-Aug | 22 | 8 | 73 | 59 | | 7 | 1 | 11 | 183 | 57 | 256 | 120 | 66 | 1,024 | 0.680 |
| 05-Aug | 6 | 47 | 10 | 151 | | 2 | 0 | 9 | 63 | 151 | 39 | 205 | 57 | 1,081 | 0.718 |
| 06-Aug | 0 | 51 | 4 | 19 | | 118 | 3 | 143 | 113 | 212 | 37 | 76 | 65 | 1,146 | 0.761 |
| 07-Aug | 0 | 7 | 10 | 37 | | 15 | 0 | 18 | 34 | 35 | 102 | 55 | 26 | 1,172 | 0.778 |
| 08-Aug | 7 | 25 | 139 | 44 | | 11 | 121 | 20 | 34 | 41 | 65 | 108 | 51 | 1,223 | 0.812 |
| 09-Aug | 19 | 15 | 27 | 41 | | | 31 | 75 | 193 | 63 | 82 | 78 | 52 | 1,275 | 0.847 |
| 10-Aug | 10 | 82 | 15 | 19 | | | 6 | 37 | 37 | 24 | 171 | 52 | 38 | 1,313 | 0.872 |
| 11-Aug | 54 | 84 | 7 | 46 | | | 4 | 30 | 164 | 28 | 18 | 20 | 38 | 1,351 | 0.897 |
| 12-Aug | 22 | 11 | 5 | 6 | | 3 | 1 | 13 | 10 | 62 | 93 | 18 | 20 | 1,371 | 0.911 |
| 13-Aug | 10 | 1 | 20 | 197 | | 10 | 29 | 5 | 9 | 113 | 73 | 91 | 47 | 1,418 | 0.942 |
| 14-Aug | 15 | 22 | 14 | 27 | | 12 | 1 | 15 | 4 | 17 | 41 | 19 | 16 | 1,433 | 0.952 |
| 15-Aug | 25 | 3 | 12 | 97 | | | 15 | 14 | 6 | 34 | 37 | 70 | 26 | 1,460 | 0.969 |
| 16-Aug | 24 | 3 | 13 | 60 | | | 12 | 3 | 4 | 6 | 52 | 54 | 19 | 1,479 | 0.982 |
| 17-Aug | 20 | 11 | 17 | | | | 9 | 5 | 3 | | 6 | 39 | 9 | 1,488 | 0.988 |
| 18-Aug | 64 | | | | | | 13 | 0 | 3 | | | 9 | 7 | 1,495 | 0.993 |
| 19-Aug | 22 | | | | | | 11 | | | | | | 3 | 1,498 | 0.995 |
| 20-Aug | 9 | | | | | | 12 | | | | | | 2 | 1,500 | 0.996 |
| 21-Aug | | | | | | | 15 | | | | | | 1 | 1,501 | 0.997 |
| 22-Aug | | | | | | | 16 | | | | | | 1 | 1,502 | 0.998 |
| 23-Aug | | | | | | | 23 | | | | | | 2 | 1,504 | 0.999 |
| 24-Aug | | | | | | | 17 | | | | | | 1 | 1,506 | 1.000 |
| Weir total | 1,941 | 1,880 | 1,103 | 1,754 | 693 | 684 | 611 | 849 | 2,201 | 1,982 | 2,572 | 1,799 | 1,506 | | |
| Add-on number | | | | | 432 | 123 | | | | | | 85 | | | |
| Estimated total | 1,941 | 1,880 | 1,103 | 1,754 | 1,125 | 807 | 611 | 849 | 2,201 | 1,982 | 2,572 | 1,884 | 1,524 | | |

[a] Weir counts in 1976, 1977, 1978 and 1987 were combined counts of large and medium-sized Chinook salmon. No small (age-.1) fish were counted at the Nine Mile Bridge location.
[b] In 1980 and 1981, 432 and 123 Chinook salmon were added to weir counts to account for weir outages.
[c] In 1987, 85 large Chinook were counted below the weir on the day it was removed, and were added to the weir count.

**Appendix B5.–**Daily weir counts of large (≥28" TL) Chinook salmon past the Situk River weir, located near tidewater, 1988-2002. [a]

| | | | | | | | | Year | | | | | | | | | Cum. | Cum. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | Avg | avg | prop. |
| 31-May | | 0 | 0 | 0 | 7 | | | 1 | 8 | 0 | 0 | 0 | 0 | 3 | 2 | 1 | 1 | 0.001 |
| 01-Jun | | 0 | 3 | 0 | 0 | | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 1 | 1 | 2 | 0.001 |
| 02-Jun | | 0 | 0 | 0 | 2 | | 0 | 1 | 0 | 4 | 0 | 0 | 0 | 2 | 0 | 1 | 3 | 0.002 |
| 03-Jun | | 1 | 0 | 0 | 1 | | 0 | 1 | 0 | 2 | 0 | 0 | 6 | 0 | 0 | 1 | 3 | 0.002 |
| 04-Jun | | 0 | 0 | 0 | 6 | | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 4 | 0.002 |
| 05-Jun | | 2 | 0 | 0 | 3 | | 1 | 0 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 5 | 0.003 |
| 06-Jun | | 0 | 1 | 0 | 7 | | 0 | 0 | 0 | 3 | 0 | 0 | 1 | 1 | 0 | 1 | 6 | 0.004 |
| 07-Jun | 0 | 0 | 1 | 0 | 2 | | 0 | 13 | 2 | 2 | 0 | 0 | 1 | 0 | 0 | 1 | 7 | 0.004 |
| 08-Jun | 0 | 0 | 0 | 0 | 4 | | 1 | 0 | 3 | 4 | 0 | 0 | 2 | 2 | 0 | 1 | 8 | 0.005 |
| 09-Jun | 0 | 0 | 1 | 0 | 7 | 4 | 0 | 2 | 0 | 44 | 0 | 0 | 7 | 1 | 0 | 4 | 13 | 0.008 |
| 10-Jun | 0 | 0 | 0 | 0 | 5 | 1 | 3 | 1 | 5 | 1 | 0 | 0 | 12 | 11 | 3 | 3 | 15 | 0.010 |
| 11-Jun | 5 | 0 | 0 | 0 | 11 | 1 | 2 | 3 | 5 | 5 | 0 | 0 | 3 | 0 | 1 | 2 | 18 | 0.011 |
| 12-Jun | 0 | 0 | 0 | 4 | 18 | 4 | 6 | 0 | 0 | 9 | 2 | 0 | 7 | 2 | 5 | 4 | 22 | 0.013 |
| 13-Jun | 9 | 0 | 0 | 0 | 18 | 3 | 0 | 0 | 4 | 16 | 9 | 7 | 19 | 0 | 0 | 6 | 27 | 0.017 |
| 14-Jun | 0 | 0 | 3 | 0 | 24 | 33 | 0 | 76 | 50 | 54 | 7 | 5 | 52 | 3 | 4 | 21 | 48 | 0.030 |
| 15-Jun | 2 | 0 | 2 | 3 | 65 | 16 | 8 | 117 | 22 | 18 | 0 | 7 | 65 | 7 | 10 | 23 | 71 | 0.044 |
| 16-Jun | 1 | 0 | 0 | 2 | 13 | 7 | 7 | 146 | 12 | 58 | 0 | 5 | 97 | 1 | 15 | 24 | 95 | 0.059 |
| 17-Jun | 1 | 6 | 6 | 1 | 33 | 6 | 12 | 81 | 12 | 4 | 5 | 0 | 85 | 8 | 2 | 17 | 112 | 0.070 |
| 18-Jun | 2 | 2 | 6 | 2 | 4 | 61 | 11 | 154 | 41 | 0 | 1 | 9 | 163 | 17 | 14 | 32 | 145 | 0.091 |
| 19-Jun | 9 | 10 | 59 | 9 | 36 | 6 | 9 | 69 | 44 | 69 | 3 | 4 | 81 | 4 | 0 | 27 | 172 | 0.108 |
| 20-Jun | 12 | 3 | 0 | 38 | 32 | 73 | 29 | 538 | 201 | 119 | 1 | 25 | 74 | 8 | 58 | 81 | 253 | 0.159 |
| 21-Jun | 3 | 11 | 19 | 20 | 113 | 6 | 49 | 37 | 55 | 56 | 47 | 100 | 39 | 2 | 31 | 39 | 292 | 0.183 |
| 22-Jun | 6 | 2 | 1 | 30 | 28 | 13 | 13 | 62 | 16 | 20 | 186 | 50 | 10 | 8 | 36 | 32 | 324 | 0.203 |
| 23-Jun | 0 | 4 | 20 | 6 | 30 | 3 | 112 | 9 | 45 | 157 | 24 | 78 | 23 | 35 | 8 | 37 | 361 | 0.226 |
| 24-Jun | 7 | 5 | 1 | 73 | 48 | 47 | 3 | 122 | 18 | 21 | 14 | 24 | 21 | 15 | 41 | 31 | 392 | 0.246 |
| 25-Jun | 4 | 37 | 11 | 85 | 20 | 1 | 25 | 353 | 148 | 5 | 0 | 37 | 45 | 14 | 20 | 54 | 446 | 0.279 |
| 26-Jun | 11 | 3 | 66 | 24 | 70 | 21 | 46 | 81 | 21 | 21 | 11 | 17 | 27 | 7 | 2 | 29 | 474 | 0.297 |
| 27-Jun | 11 | 19 | 8 | 31 | 59 | 72 | 4 | 373 | 61 | 84 | 23 | 7 | 26 | 10 | 28 | 54 | 529 | 0.331 |
| 28-Jun | 22 | 65 | 43 | 29 | 170 | 13 | 22 | 25 | 72 | 107 | 44 | 155 | 31 | 2 | 61 | 57 | 586 | 0.367 |
| 29-Jun | 49 | 8 | 8 | 92 | 53 | 11 | 51 | 70 | 39 | 142 | 16 | 123 | 101 | 1 | 46 | 54 | 640 | 0.401 |
| 30-Jun | 40 | 7 | 3 | 51 | 32 | 13 | 180 | 41 | 101 | 58 | 10 | 30 | 66 | 27 | 44 | 47 | 687 | 0.430 |
| 01-Jul | 3 | 12 | 7 | 26 | 40 | 21 | 7 | 86 | 39 | 15 | 18 | 70 | 223 | 22 | 33 | 41 | 728 | 0.456 |
| 02-Jul | 10 | 12 | 1 | 34 | 6 | 0 | 21 | 97 | 39 | 0 | 66 | 52 | 127 | 30 | 30 | 35 | 763 | 0.478 |
| 03-Jul | 9 | 10 | 28 | 114 | 4 | 24 | 80 | 130 | 92 | 10 | 65 | 90 | 134 | 13 | 17 | 55 | 818 | 0.512 |
| 04-Jul | 7 | 27 | 42 | 9 | 33 | 29 | 36 | 120 | 28 | 11 | 13 | 91 | 32 | 9 | 21 | 34 | 852 | 0.534 |
| 05-Jul | 2 | 6 | 1 | 0 | 16 | 15 | 243 | 168 | 38 | 66 | 11 | 68 | 2 | 11 | 39 | 46 | 898 | 0.562 |
| 06-Jul | 4 | 0 | 0 | 21 | 14 | 25 | 11 | 84 | 50 | 33 | 121 | 98 | 44 | 64 | 50 | 41 | 939 | 0.588 |
| 07-Jul | 18 | 9 | 2 | 41 | 82 | 15 | 35 | 77 | 111 | 25 | 18 | 35 | 51 | 17 | 107 | 43 | 982 | 0.615 |
| 08-Jul | 11 | 6 | 3 | 10 | 61 | 50 | 19 | 34 | 53 | 9 | 64 | 55 | 129 | 43 | 60 | 40 | 1,022 | 0.640 |
| 09-Jul | 9 | 14 | 67 | 11 | 24 | 28 | 2 | 60 | 98 | 9 | 83 | 7 | 41 | 43 | 21 | 34 | 1,057 | 0.662 |
| 10-Jul | 21 | 77 | 25 | 20 | 19 | 17 | 17 | 38 | 34 | 12 | 20 | 44 | 136 | 11 | 2 | 33 | 1,090 | 0.682 |
| 11-Jul | 13 | 15 | 1 | 11 | 23 | 43 | 26 | 20 | 51 | 72 | 31 | 18 | 10 | 2 | 6 | 23 | 1,112 | 0.697 |
| 12-Jul | 57 | 9 | 0 | 5 | 52 | 17 | 6 | 80 | 4 | 518 | 119 | 6 | 33 | 0 | 4 | 61 | 1,173 | 0.735 |
| 13-Jul | 23 | 16 | 5 | 17 | 38 | 1 | 22 | 176 | 9 | 71 | 25 | 110 | 12 | 13 | 28 | 38 | 1,211 | 0.758 |
| 14-Jul | 16 | 12 | 2 | 6 | 24 | 13 | 5 | 32 | 45 | 33 | 50 | 48 | 60 | 52 | 14 | 27 | 1,238 | 0.775 |

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**Appendix B5.–**Page 2 of 2.

| | Year | | | | | | | | | | | | | | | | Cum. | Cum. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | Avg | avg | prop. |
| 15-Jul | 1 | 0 | 12 | 10 | 22 | 10 | 3 | 99 | 60 | 26 | 30 | 53 | 15 | 16 | 4 | 24 | 1,262 | 0.791 |
| 16-Jul | 6 | 0 | 127 | 9 | 12 | 13 | 1 | 58 | 46 | 54 | 36 | 46 | 11 | 19 | 54 | 33 | 1,295 | 0.811 |
| 17-Jul | 9 | 1 | 1 | 12 | 26 | 1 | 2 | 170 | 60 | 24 | 3 | 19 | 94 | 11 | 0 | 29 | 1,324 | 0.829 |
| 18-Jul | 17 | 26 | 1 | 11 | 114 | 3 | 11 | 55 | 51 | 64 | 19 | 1 | 17 | 8 | 44 | 29 | 1,353 | 0.848 |
| 19-Jul | 27 | 17 | 0 | 5 | 0 | 11 | 10 | 20 | 17 | 18 | 4 | 17 | 18 | 22 | 0 | 12 | 1,366 | 0.855 |
| 20-Jul | 19 | 16 | 11 | 4 | 10 | 10 | 81 | 46 | 23 | 86 | 1 | 28 | 9 | 15 | 4 | 24 | 1,390 | 0.871 |
| 21-Jul | 13 | 16 | 14 | 15 | 2 | 17 | 3 | 5 | 3 | 48 | 4 | 13 | 22 | 12 | 1 | 13 | 1,403 | 0.878 |
| 22-Jul | 0 | 1 | 3 | 4 | 6 | 7 | 2 | 18 | 6 | 23 | 62 | 8 | 77 | 28 | 0 | 16 | 1,419 | 0.889 |
| 23-Jul | 212 | 3 | 6 | 1 | 10 | 34 | 3 | 3 | 3 | 19 | 15 | 20 | 21 | 12 | 9 | 25 | 1,444 | 0.904 |
| 24-Jul | 4 | 0 | 1 | 0 | 4 | 6 | 3 | 23 | 21 | 28 | 53 | 1 | 4 | 3 | 19 | 11 | 1,455 | 0.911 |
| 25-Jul | 46 | 7 | 3 | 0 | 11 | 1 | 5 | 304 | 9 | 5 | 6 | 3 | 16 | 4 | 2 | 28 | 1,483 | 0.929 |
| 26-Jul | 2 | 12 | 0 | 0 | 1 | 3 | 6 | 24 | 4 | 76 | 5 | 1 | 20 | 7 | 7 | 11 | 1,494 | 0.936 |
| 27-Jul | 72 | 31 | 2 | 1 | 0 | 2 | 3 | 23 | 2 | 49 | 2 | 4 | 11 | 4 | 2 | 14 | 1,508 | 0.945 |
| 28-Jul | 0 | 32 | 1 | | 4 | 1 | 20 | 31 | 12 | 57 | 2 | 101 | 12 | 7 | 0 | 19 | 1,527 | 0.956 |
| 29-Jul | 1 | 27 | | | 0 | 3 | 0 | 20 | 9 | 7 | 0 | 120 | 12 | 1 | 0 | 13 | 1,540 | 0.965 |
| 30-Jul | 21 | 2 | | | 10 | 1 | 19 | 100 | 20 | 21 | 0 | 14 | 9 | 0 | 0 | 14 | 1,555 | 0.974 |
| 31-Jul | 0 | 0 | | | 10 | 3 | 0 | 47 | 11 | 4 | 0 | 5 | 20 | 0 | 2 | 7 | 1,561 | 0.978 |
| 01-Aug | 9 | 1 | | | 10 | 2 | 4 | 23 | 28 | 15 | 2 | 4 | 8 | 0 | 3 | 7 | 1,569 | 0.982 |
| 02-Aug | 6 | 2 | | | 1 | 11 | 1 | 7 | 64 | 16 | 0 | 1 | 4 | 0 | 0 | 8 | 1,576 | 0.987 |
| 03-Aug | 3 | 3 | | | 1 | 13 | 4 | 43 | 15 | 37 | 1 | 7 | 4 | 1 | 1 | 9 | 1,585 | 0.993 |
| 04-Aug | 4 | 18 | | | 3 | 5 | 6 | | 9 | 18 | 0 | 3 | 3 | 0 | 2 | 5 | 1,590 | 0.996 |
| 05-Aug | 0 | 4 | | | 4 | 1 | | | 11 | 9 | 1 | 0 | 3 | 1 | 2 | 2 | 1,592 | 0.997 |
| 06-Aug | 2 | 2 | | | | | | | 12 | 7 | 0 | 3 | 5 | 1 | 2 | 2 | 1,594 | 0.999 |
| 07-Aug | 0 | 0 | | | | | | | | 10 | 0 | | 2 | | 0 | 1 | 1,595 | 0.999 |
| 08-Aug | 0 | 1 | | | | | | | | | | | 1 | | 0 | 0 | 1,595 | 0.999 |
| 09-Aug | 1 | 1 | | | | | | | | | | | | | 0 | 0 | 1,596 | 0.999 |
| 10-Aug | 0 | 0 | | | | | | | | | | | | | 0 | 0 | 1,596 | 0.999 |
| 11-Aug | 0 | 0 | | | | | | | | | | | | | 0 | 0 | 1,596 | 0.999 |
| 12-Aug | 0 | 0 | | | | | | | | | | | | | 0 | 0 | 1,596 | 0.999 |
| 13-Aug | 0 | 1 | | | | | | | | | | | | | 0 | 0 | 1,596 | 0.999 |
| 14-Aug | 1 | 1 | | | | | | | | | | | | | 0 | 0 | 1,596 | 0.999 |
| 15-Aug | 0 | 1 | | | | | | | | | | | | | 0 | 0 | 1,596 | 0.999 |
| 16-Aug | 0 | 1 | | | | | | | | | | | | | 0 | 0 | 1,596 | 0.999 |
| 17-Aug | 2 | | | | | | | | | | | | | | 0 | 0 | 1,596 | 1.000 |
| 18-Aug | 1 | | | | | | | | | | | | | | 0 | 0 | 1,596 | 1.000 |
| 19-Aug | 4 | | | | | | | | | | | | | | | 0 | 1,596 | 1.000 |
| 20-Aug | 4 | | | | | | | | | | | | | | | 0 | 1,597 | 1.000 |
| 21-Aug | 1 | | | | | | | | | | | | | | | 0 | 1,597 | 1.000 |
| Weir total | 885 | 637 | 628 | 897 | 1,618 | 871 | 1,311 | 4,700 | 2,175 | 2,690 | 1,353 | 1,947 | 2,518 | 696 | 1,024 | 1,597 | | |
| Add-on number | | | | | | 109 | | | | | | | | | | | | |
| Estimated total | 885 | 637 | 628 | 897 | 1,618 | 980 | 1,311 | 4,700 | 2,175 | 2,690 | 1,353 | 1,947 | 2,518 | 696 | 1,024 | 1,604 | | |

[a] In 1993, 109 large Chinook were counted below the weir on the day it was removed, and were added to the weir count of large Chinook salmon.

**Appendix B6–** Daily weir counts of medium (20-28" TL) Chinook salmon past the Situk River weir, located near tidewater, 1988-2002. [a]

| | Year | | | | | | | | | | | | | | | | Cum. | Cum. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | Avg | avg | prop. |
| 31-May | | | 0 | 0 | 0 | | | 2 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0.001 |
| 01-Jun | | | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0.001 |
| 02-Jun | | | 0 | 0 | 0 | | 0 | 2 | 0 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0.002 |
| 03-Jun | | | 0 | 0 | 5 | | 0 | 2 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0.004 |
| 04-Jun | | | 0 | 0 | 0 | | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 0.004 |
| 05-Jun | | | 0 | 0 | 0 | | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0.005 |
| 06-Jun | | | 0 | 0 | 3 | | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0.006 |
| 07-Jun | | | 1 | 0 | 0 | | 2 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 0.008 |
| 08-Jun | 0 | | 0 | 0 | 1 | | 5 | 1 | 0 | 6 | 0 | 0 | 1 | 0 | 0 | 1 | 5 | 0.010 |
| 09-Jun | 0 | | 2 | 0 | 4 | 0 | 0 | 1 | 0 | 14 | 0 | 0 | 0 | 0 | 3 | 2 | 6 | 0.013 |
| 10-Jun | 0 | | 0 | 3 | 1 | 2 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 7 | 0.015 |
| 11-Jun | 0 | | 0 | 0 | 3 | 0 | 2 | 0 | 1 | 0 | 4 | 0 | 1 | 0 | 0 | 1 | 8 | 0.016 |
| 12-Jun | 0 | | 0 | 0 | 3 | 0 | 5 | 0 | 0 | 2 | 10 | 0 | 0 | 0 | 1 | 2 | 9 | 0.020 |
| 13-Jun | 0 | | 0 | 0 | 1 | 2 | 0 | 1 | 1 | 1 | 124 | 10 | 0 | 0 | 0 | 10 | 19 | 0.041 |
| 14-Jun | 0 | | 1 | 0 | 1 | 7 | 1 | 83 | 3 | 4 | 36 | 0 | 10 | 0 | 1 | 11 | 30 | 0.063 |
| 15-Jun | 0 | | 1 | 0 | 0 | 14 | 8 | 10 | 2 | 2 | 0 | 1 | 3 | 0 | 5 | 3 | 33 | 0.069 |
| 16-Jun | 0 | | 0 | 0 | 1 | 5 | 26 | 22 | 2 | 6 | 0 | 1 | 2 | 0 | 27 | 7 | 40 | 0.083 |
| 17-Jun | 0 | | 3 | 0 | 1 | 3 | 21 | 8 | 2 | 0 | 12 | 0 | 10 | 0 | 1 | 4 | 44 | 0.092 |
| 18-Jun | 0 | | 6 | 0 | 1 | 8 | 9 | 12 | 4 | 0 | 4 | 4 | 15 | 1 | 2 | 5 | 49 | 0.102 |
| 19-Jun | 0 | | 35 | 1 | 2 | 2 | 12 | 6 | 18 | 6 | 0 | 0 | 4 | 1 | 2 | 6 | 55 | 0.115 |
| 20-Jun | 0 | | 0 | 2 | 3 | 23 | 28 | 15 | 36 | 5 | 2 | 2 | 5 | 0 | 15 | 10 | 65 | 0.136 |
| 21-Jun | 0 | | 23 | 5 | 0 | 0 | 68 | 3 | 17 | 6 | 42 | 5 | 3 | 0 | 8 | 13 | 78 | 0.163 |
| 22-Jun | 3 | | 0 | 14 | 1 | 11 | 37 | 2 | 3 | 1 | 172 | 5 | 1 | 0 | 16 | 19 | 97 | 0.203 |
| 23-Jun | 0 | | 12 | 0 | 2 | 6 | 88 | 1 | 10 | 5 | 5 | 19 | 1 | 2 | 20 | 12 | 109 | 0.228 |
| 24-Jun | 0 | | 5 | 5 | 6 | 20 | 17 | 14 | 2 | 6 | 11 | 2 | 1 | 1 | 37 | 9 | 118 | 0.247 |
| 25-Jun | 0 | | 13 | 14 | 7 | 1 | 44 | 87 | 11 | 4 | 2 | 3 | 0 | 1 | 13 | 14 | 132 | 0.277 |
| 26-Jun | 0 | | 54 | 1 | 7 | 23 | 48 | 5 | 6 | 5 | 5 | 1 | 2 | 0 | 1 | 11 | 144 | 0.301 |
| 27-Jun | 1 | | 7 | 5 | 6 | 17 | 19 | 32 | 16 | 16 | 12 | 5 | 3 | 5 | 11 | 11 | 155 | 0.324 |
| 28-Jun | 4 | | 42 | 3 | 23 | 11 | 21 | 4 | 20 | 9 | 2 | 9 | 2 | 0 | 17 | 12 | 167 | 0.349 |
| 29-Jun | 5 | | 14 | 6 | 10 | 12 | 57 | 2 | 2 | 38 | 7 | 21 | 7 | 0 | 14 | 14 | 181 | 0.378 |
| 30-Jun | 1 | | 6 | 6 | 24 | 11 | 133 | 1 | 9 | 22 | 16 | 8 | 5 | 5 | 16 | 19 | 199 | 0.417 |
| 01-Jul | 0 | | 6 | 6 | 1 | 13 | 1 | 8 | 30 | 3 | 5 | 10 | 32 | 2 | 10 | 9 | 208 | 0.436 |
| 02-Jul | 10 | | 10 | 6 | 4 | 1 | 19 | 8 | 10 | 0 | 12 | 8 | 7 | 5 | 11 | 8 | 216 | 0.453 |
| 03-Jul | 4 | | 23 | 17 | 0 | 20 | 98 | 11 | 16 | 2 | 41 | 18 | 17 | 2 | 8 | 20 | 236 | 0.494 |
| 04-Jul | 0 | | 6 | 2 | 3 | 11 | 33 | 12 | 22 | 15 | 9 | 21 | 2 | 0 | 7 | 10 | 246 | 0.516 |
| 05-Jul | 0 | | 5 | 0 | 5 | 16 | 118 | 26 | 24 | 26 | 1 | 10 | 0 | 1 | 12 | 17 | 264 | 0.552 |
| 06-Jul | 0 | | 0 | 2 | 3 | 17 | 5 | 19 | 26 | 9 | 34 | 17 | 1 | 7 | 26 | 12 | 276 | 0.577 |
| 07-Jul | 5 | | 6 | 2 | 12 | 7 | 25 | 17 | 55 | 12 | 15 | 2 | 0 | 3 | 37 | 14 | 290 | 0.607 |
| 08-Jul | 10 | | 8 | 5 | 6 | 12 | 23 | 6 | 8 | 5 | 24 | 9 | 7 | 7 | 21 | 11 | 301 | 0.629 |
| 09-Jul | 0 | | 15 | 5 | 8 | 11 | 3 | 5 | 47 | 6 | 27 | 2 | 1 | 2 | 9 | 10 | 311 | 0.650 |
| 10-Jul | 3 | | 20 | 3 | 7 | 9 | 35 | 9 | 31 | 9 | 4 | 5 | 3 | 0 | 0 | 10 | 320 | 0.671 |
| 11-Jul | 4 | | 5 | 0 | 2 | 21 | 54 | 2 | 13 | 26 | 16 | 4 | 0 | 3 | 8 | 11 | 332 | 0.695 |
| 12-Jul | 13 | | 1 | 1 | 7 | 21 | 35 | 21 | 10 | 88 | 56 | 0 | 0 | 0 | 9 | 19 | 350 | 0.734 |
| 13-Jul | 15 | | 9 | 0 | 7 | 2 | 27 | 23 | 12 | 17 | 23 | 14 | 0 | 2 | 17 | 12 | 362 | 0.759 |
| 14-Jul | 4 | | 0 | 3 | 10 | 3 | 12 | 7 | 12 | 14 | 28 | 12 | 2 | 13 | 5 | 9 | 371 | 0.778 |
| 15-Jul | 6 | | 32 | 6 | 12 | 10 | 21 | 16 | 22 | 10 | 5 | 18 | 0 | 11 | 2 | 12 | 384 | 0.803 |

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**Appendix B5. –**Page 2 of 2.

| | Year | | | | | | | | | | | | | | | | Cum. | Cum. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | Avg | avg | prop. |
| 16-Jul | 5 | | 43 | 1 | 4 | 14 | 3 | 4 | 9 | 21 | 17 | 8 | 0 | 8 | 27 | 12 | 395 | 0.828 |
| 17-Jul | 7 | | 6 | 3 | 2 | 0 | 2 | 11 | 12 | 13 | 2 | 1 | 5 | 5 | 1 | 5 | 400 | 0.838 |
| 18-Jul | 10 | | 3 | 0 | 18 | 1 | 28 | 8 | 26 | 18 | 13 | 0 | 1 | 2 | 15 | 10 | 411 | 0.860 |
| 19-Jul | 12 | | 2 | 2 | 0 | 30 | 30 | 3 | 11 | 15 | 13 | 3 | 0 | 3 | 0 | 9 | 419 | 0.878 |
| 20-Jul | 1 | | 16 | 0 | 0 | 7 | 80 | 15 | 1 | 23 | 4 | 7 | 0 | 5 | 0 | 11 | 431 | 0.902 |
| 21-Jul | 1 | | 21 | 1 | 0 | 11 | 7 | 3 | 0 | 17 | 5 | 2 | 1 | 1 | 0 | 5 | 436 | 0.912 |
| 22-Jul | 0 | | 16 | 0 | 0 | 6 | 6 | 5 | 8 | 6 | 18 | 1 | 0 | 3 | 0 | 5 | 441 | 0.923 |
| 23-Jul | 16 | | 9 | 0 | 2 | 2 | 7 | 1 | 3 | 6 | 0 | 7 | 1 | 1 | 1 | 4 | 445 | 0.931 |
| 24-Jul | 0 | | 5 | 0 | 0 | 4 | 9 | 4 | 3 | 6 | 4 | 0 | 0 | | 3 | 3 | 447 | 0.937 |
| 25-Jul | 7 | | 3 | 0 | 2 | 9 | 12 | 11 | 2 | 4 | 0 | 1 | 1 | | 1 | 4 | 451 | 0.945 |
| 26-Jul | 2 | | 0 | 2 | 1 | 13 | 17 | 2 | 2 | 12 | 4 | 1 | 0 | | 0 | 4 | 455 | 0.953 |
| 27-Jul | 9 | | 4 | 0 | 1 | 8 | 11 | 6 | 1 | 8 | 1 | 3 | 1 | | 1 | 4 | 459 | 0.961 |
| 28-Jul | 2 | | 0 | 0 | 1 | 5 | 43 | 2 | 0 | 8 | | 13 | 0 | | 1 | 5 | 464 | 0.972 |
| 29-Jul | 0 | | | | 0 | 4 | 2 | 1 | 2 | 2 | | 6 | 0 | | 0 | 1 | 466 | 0.975 |
| 30-Jul | 22 | | | | 2 | 2 | 30 | 14 | 0 | 0 | | 0 | 0 | | 0 | 5 | 471 | 0.985 |
| 31-Jul | 0 | | | | 0 | 1 | 2 | 8 | 2 | 0 | | 1 | 1 | | 0 | 1 | 472 | 0.988 |
| 01-Aug | 0 | | | | 0 | 4 | 7 | 6 | 1 | 0 | | 0 | 0 | | 1 | 1 | 473 | 0.991 |
| 02-Aug | 6 | | | | 0 | 9 | 1 | 0 | 4 | 0 | | 0 | 0 | | 0 | 1 | 474 | 0.994 |
| 03-Aug | 0 | | | | 0 | 2 | 3 | 0 | 2 | 5 | | 0 | 0 | | 2 | 1 | 475 | 0.996 |
| 04-Aug | 0 | | | | 0 | 2 | 7 | | 2 | 0 | | 0 | 0 | | 1 | 1 | 476 | 0.997 |
| 05-Aug | 0 | | | | 0 | 4 | | | 2 | 2 | | 1 | 0 | | 0 | 1 | 477 | 0.999 |
| 06-Aug | 2 | | | | | | | | 3 | 0 | | 0 | 0 | | 0 | 0 | 477 | 1.000 |
| 07-Aug | 0 | | | | | | | | 0 | 0 | | 0 | 0 | | | 0 | 477 | 1.000 |
| 08-Aug | 0 | | | | | | | | | | | | 0 | | | 0 | 477 | 1.000 |
| 09-Aug | 0 | | | | | | | | | | | | | | | 0 | 477 | 1.000 |
| 10-Aug | 0 | | | | | | | | | | | | | | | 0 | 477 | 1.000 |
| 11-Aug | 0 | | | | | | | | | | | | | | | 0 | 477 | 1.000 |
| 12-Aug | 0 | | | | | | | | | | | | | | | 0 | 477 | 1.000 |
| 13-Aug | 2 | | | | | | | | | | | | | | | 0 | 477 | 1.000 |
| 14-Aug | 0 | | | | | | | | | | | | | | | 0 | 477 | 1.000 |
| 15-Aug | 0 | | | | | | | | | | | | | | | 0 | 477 | 1.000 |
| 16-Aug | 0 | | | | | | | | | | | | | | | 0 | 477 | 1.000 |
| 17-Aug | 0 | | | | | | | | | | | | | | | 0 | 477 | 1.000 |
| 18-Aug | 0 | | | | | | | | | | | | | | | 0 | 477 | 1.000 |
| 19-Aug | 0 | | | | | | | | | | | | | | | 0 | 477 | 1.000 |
| 20-Aug | 0 | | | | | | | | | | | | | | | 0 | 477 | 1.000 |
| 21-Aug | 1 | | | | | | | | | | | | | | | 0 | 478 | 1.000 |
| Weir total | 193 | | 499 | 132 | 236 | 490 | 1,471 | 617 | 602 | 582 | 851 | 301 | 161 | 102 | 448 | 478 | | |

[a] Weir counts in 1989 were combined counts of small and medium-sized Chinook salmon. The number of medium Chinook was estimated from the field observation of 20% medium-sized Chinook salmon.

**Appendix B7.–**Daily weir counts of small (<440 mm MEF) Chinook salmon past the Situk River weir, located near tidewater, 1988-2002. [a]

| | Year | | | | | | | | | | | | | | | | Cum. | Cum. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | Avg | avg | prop. |
| 31-May | | 0 | 0 | 0 | 0 | | | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.000 |
| 01-Jun | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.000 |
| 02-Jun | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.000 |
| 03-Jun | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.000 |
| 04-Jun | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.000 |
| 05-Jun | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.000 |
| 06-Jun | | 0 | 0 | 0 | 1 | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0.001 |
| 07-Jun | | 0 | 2 | 0 | 0 | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.001 |
| 08-Jun | | 0 | 0 | 0 | 0 | | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.001 |
| 09-Jun | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.001 |
| 10-Jun | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 0.001 |
| 11-Jun | | 0 | 0 | 0 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.002 |
| 12-Jun | | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.002 |
| 13-Jun | | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 1 | 3 | 0.003 |
| 14-Jun | | 0 | 1 | 0 | 0 | 2 | 0 | 5 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 1 | 4 | 0.004 |
| 15-Jun | | 1 | 9 | 0 | 0 | 0 | 17 | 0 | 0 | 2 | 0 | 15 | 8 | 0 | 1 | 4 | 8 | 0.007 |
| 16-Jun | | 0 | 0 | 0 | 0 | 1 | 22 | 2 | 0 | 7 | 0 | 1 | 0 | 0 | 0 | 2 | 11 | 0.009 |
| 17-Jun | | 5 | 12 | 0 | 0 | 6 | 14 | 0 | 0 | 0 | 6 | 0 | 7 | 0 | 0 | 4 | 14 | 0.011 |
| 18-Jun | | 1 | 8 | 0 | 0 | 30 | 2 | 8 | 0 | 0 | 2 | 0 | 4 | 0 | 1 | 4 | 18 | 0.015 |
| 19-Jun | | 22 | 20 | 0 | 0 | 9 | 4 | 2 | 25 | 15 | 0 | 0 | 1 | 0 | 0 | 7 | 25 | 0.020 |
| 20-Jun | | 8 | 0 | 14 | 0 | 68 | 5 | 11 | 21 | 18 | 0 | 0 | 0 | 0 | 8 | 11 | 36 | 0.029 |
| 21-Jun | | 19 | 7 | 2 | 0 | 1 | 16 | 3 | 16 | 5 | 35 | 32 | 3 | 0 | 3 | 10 | 46 | 0.037 |
| 22-Jun | | 2 | 0 | 3 | 0 | 59 | 34 | 0 | 0 | 2 | 94 | 1 | 0 | 4 | 4 | 15 | 61 | 0.049 |
| 23-Jun | | 12 | 1 | 2 | 1 | 75 | 115 | 0 | 14 | 3 | 15 | 34 | 0 | 4 | 0 | 20 | 80 | 0.065 |
| 24-Jun | | 18 | 2 | 0 | 1 | 61 | 4 | 12 | 0 | 0 | 29 | 7 | 0 | 10 | 5 | 11 | 91 | 0.074 |
| 25-Jun | | 25 | 7 | 16 | 0 | 22 | 50 | 4 | 11 | 5 | 0 | 8 | 3 | 3 | 12 | 12 | 103 | 0.084 |
| 26-Jun | | 6 | 9 | 2 | 0 | 130 | 21 | 5 | 6 | 87 | 9 | 1 | 3 | 0 | 4 | 20 | 123 | 0.100 |
| 27-Jun | | 28 | 1 | 3 | 4 | 109 | 20 | 33 | 20 | 150 | 27 | 2 | 1 | 2 | 10 | 29 | 152 | 0.124 |
| 28-Jun | | 24 | 3 | 4 | 4 | 90 | 6 | 8 | 44 | 71 | 0 | 22 | 7 | 0 | 14 | 21 | 174 | 0.141 |
| 29-Jun | | 13 | 2 | 12 | 7 | 68 | 85 | 8 | 23 | 182 | 79 | 4 | 8 | 2 | 10 | 36 | 210 | 0.170 |
| 30-Jun | | 33 | 0 | 15 | 0 | 149 | 151 | 0 | 24 | 33 | 24 | 2 | 6 | 54 | 0 | 35 | 245 | 0.199 |
| 01-Jul | | 21 | 0 | 5 | 1 | 153 | 7 | 33 | 52 | 32 | 32 | 24 | 17 | 23 | 5 | 29 | 274 | 0.222 |
| 02-Jul | | 51 | 2 | 5 | 2 | 15 | 44 | 57 | 43 | 3 | 25 | 5 | 61 | 19 | 7 | 24 | 298 | 0.242 |
| 03-Jul | | 40 | 0 | 69 | 0 | 148 | 85 | 181 | 64 | 119 | 75 | 21 | 85 | 23 | 11 | 66 | 364 | 0.295 |
| 04-Jul | | 57 | 3 | 11 | 6 | 111 | 32 | 133 | 33 | 93 | 11 | 33 | 4 | 0 | 4 | 38 | 401 | 0.326 |
| 05-Jul | | 42 | 0 | 0 | 0 | 25 | 129 | 282 | 82 | 148 | 2 | 27 | 0 | 3 | 10 | 54 | 455 | 0.370 |
| 06-Jul | | 3 | 0 | 32 | 10 | 191 | 31 | 105 | 51 | 30 | 99 | 31 | 0 | 49 | 18 | 46 | 501 | 0.407 |
| 07-Jul | | 56 | 5 | 26 | 9 | 147 | 44 | 321 | 107 | 34 | 9 | 11 | 0 | 18 | 53 | 60 | 561 | 0.456 |
| 08-Jul | | 40 | 1 | 19 | 5 | 182 | 48 | 277 | 32 | 34 | 56 | 4 | 48 | 3 | 7 | 54 | 615 | 0.500 |
| 09-Jul | | 56 | 0 | 75 | 10 | 137 | 4 | 186 | 95 | 6 | 39 | 18 | 7 | 30 | 8 | 48 | 663 | 0.539 |
| 10-Jul | | 96 | 3 | 23 | 10 | 45 | 27 | 96 | 72 | 46 | 13 | 29 | 50 | 0 | 5 | 37 | 700 | 0.569 |
| 11-Jul | | 40 | 0 | 5 | 4 | 71 | 48 | 29 | 31 | 97 | 103 | 5 | 1 | 29 | 10 | 34 | 734 | 0.596 |
| 12-Jul | | 52 | 0 | 34 | 6 | 115 | 65 | 218 | 36 | 238 | 552 | 2 | 4 | 0 | 15 | 96 | 829 | 0.674 |
| 13-Jul | | 31 | 1 | 49 | 3 | 20 | 36 | 159 | 54 | 43 | 218 | 30 | 4 | 46 | 21 | 51 | 881 | 0.715 |
| 14-Jul | | 41 | 0 | 39 | 0 | 82 | 64 | 52 | 44 | 16 | 344 | 14 | 38 | 27 | 10 | 55 | 936 | 0.760 |
| 15-Jul | | 21 | 7 | 21 | 15 | 69 | 87 | 117 | 88 | 20 | 288 | 11 | 3 | 14 | 5 | 55 | 990 | 0.805 |

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**Appendix B7. –**Page 2 of 2.

| Date | Year | | | | | | | | | | | | | | | | Cum. avg | Cum. prop. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | Avg | | |
| 16-Jul | | 15 | 8 | 11 | 3 | 74 | 23 | 38 | 58 | 32 | 450 | 19 | 0 | 28 | 13 | 55 | 1,045 | 0.849 |
| 17-Jul | | 25 | 6 | 23 | 5 | 12 | 7 | 76 | 44 | 11 | 25 | 7 | 5 | 5 | 1 | 18 | 1,063 | 0.864 |
| 18-Jul | | 76 | 1 | 7 | 14 | 15 | 33 | 55 | 65 | 14 | 196 | 0 | 0 | 29 | 17 | 37 | 1,101 | 0.894 |
| 19-Jul | | 74 | 1 | 18 | 0 | 51 | 33 | 41 | 11 | 12 | 54 | 7 | 0 | 9 | 0 | 22 | 1,123 | 0.912 |
| 20-Jul | | 58 | 6 | 13 | 0 | 7 | 68 | 59 | 14 | 25 | 26 | 16 | 0 | 5 | 3 | 21 | 1,144 | 0.930 |
| 21-Jul | | 41 | 2 | 19 | 0 | 23 | 6 | 8 | 17 | 23 | 2 | 0 | 0 | 7 | 0 | 11 | 1,155 | 0.938 |
| 22-Jul | | 0 | 3 | 3 | 0 | 36 | 12 | 36 | 15 | 9 | 47 | 3 | 11 | 7 | 1 | 13 | 1,168 | 0.949 |
| 23-Jul | | 12 | 4 | 0 | 0 | 7 | 17 | 13 | 2 | 13 | 16 | 3 | 5 | 3 | 0 | 7 | 1,175 | 0.954 |
| 24-Jul | | 0 | 2 | 0 | 0 | 20 | 19 | 20 | 10 | 4 | 11 | 1 | 0 | 2 | 4 | 7 | 1,181 | 0.960 |
| 25-Jul | | 17 | 2 | 1 | 0 | 13 | 18 | 66 | 7 | 3 | 0 | 0 | 2 | 0 | 0 | 9 | 1,191 | 0.967 |
| 26-Jul | | 4 | 1 | 2 | 2 | 11 | 12 | 6 | 7 | 10 | 4 | 0 | 1 | 1 | 0 | 4 | 1,195 | 0.971 |
| 27-Jul | | 8 | 1 | 0 | 1 | 7 | 11 | 1 | 2 | 3 | 16 | 1 | 2 | 0 | 0 | 4 | 1,199 | 0.974 |
| 28-Jul | | 7 | 0 | | 0 | 6 | 20 | 19 | 2 | 10 | 31 | 9 | 2 | 0 | 0 | 8 | 1,206 | 0.980 |
| 29-Jul | | 1 | | | 0 | 14 | 1 | 5 | 5 | 2 | 24 | 6 | 1 | 0 | 0 | 4 | 1,211 | 0.984 |
| 30-Jul | | 1 | | | 0 | 2 | 16 | 78 | 1 | 2 | 2 | 4 | 4 | 1 | 0 | 8 | 1,219 | 0.990 |
| 31-Jul | | 4 | | | 7 | 6 | 1 | 14 | 6 | 0 | 3 | 1 | 0 | 1 | 0 | 3 | 1,222 | 0.992 |
| 01-Aug | | 1 | | | 0 | 11 | 2 | 15 | 2 | 0 | 8 | 2 | 0 | 0 | 0 | 3 | 1,225 | 0.995 |
| 02-Aug | | 2 | | | 0 | 12 | 2 | 0 | 5 | 0 | 5 | 0 | 3 | 0 | 0 | 2 | 1,227 | 0.997 |
| 03-Aug | | 1 | | | 0 | 3 | 0 | 17 | 8 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 1,229 | 0.998 |
| 04-Aug | | 1 | | | 0 | 4 | 2 | | 2 | 3 | | 0 | 1 | 0 | 0 | 1 | 1,230 | 0.999 |
| 05-Aug | | 1 | | | 0 | 4 | | | 1 | 0 | | 0 | 1 | 0 | 0 | 1 | 1,230 | 0.999 |
| 06-Aug | | 0 | | | | | | | 2 | 3 | | 0 | 0 | 0 | 0 | 0 | 1,231 | 1.000 |
| 07-Aug | | 0 | | | | | | | | 0 | | 0 | 1 | 0 | 0 | 0 | 1,231 | 1.000 |
| 08-Aug | | 1 | | | | | | | | | | | 0 | 1 | 0 | 0 | 1,231 | 1.000 |
| 09-Aug | | 0 | | | | | | | | | | | | | 0 | 0 | 1,231 | 1.000 |
| 10-Aug | | 0 | | | | | | | | | | | | | 0 | 0 | 1,231 | 1.000 |
| 11-Aug | | 0 | | | | | | | | | | | | | 0 | 0 | 1,231 | 1.000 |
| 12-Aug | | 0 | | | | | | | | | | | | | 0 | 0 | 1,231 | 1.000 |
| 13-Aug | | 1 | | | | | | | | | | | | | 0 | 0 | 1,231 | 1.000 |
| 14-Aug | | 0 | | | | | | | | | | | | | 0 | 0 | 1,231 | 1.000 |
| 15-Aug | | 0 | | | | | | | | | | | | | 0 | 0 | 1,231 | 1.000 |
| 16-Aug | | 0 | | | | | | | | | | | | | 0 | 0 | 1,231 | 1.000 |
| 17-Aug | | 0 | | | | | | | | | | | | | 0 | 0 | 1,231 | 1.000 |
| 18-Aug | | | | | | | | | | | | | | | 0 | 0 | 1,231 | 1.000 |
| 19-Aug | | | | | | | | | | | | | | | | 0 | 1,231 | 1.000 |
| 20-Aug | | | | | | | | | | | | | | | | 0 | 1,231 | 1.000 |
| 21-Aug | | | | | | | | | | | | | | | | 0 | 1,231 | 1.000 |
| Weir total | | 1,215 | 147 | 584 | 131 | 2,730 | 1,634 | 2,914 | 1,374 | 1,729 | 3,125 | 473 | 413 | 463 | 300 | 1,231 | | |
| Weir total | | 1,215 | 147 | 584 | 131 | 2,730 | 1,634 | 2,914 | 1,374 | 1,729 | 3,125 | 473 | 413 | 463 | 300 | 1,231 | | |

[a] The weir count in 1989 includes both small and medium-sized Chinook salmon; 972 (80%) were estimated to be age-.1 fish from field observations (Doug Mecum, pers. comm.).

**Appendix B8.–**Daily weir counts of large, medium and small Chinook salmon past the Situk River weir, located near tidewater, 1988-2002. [a]

| | Year | | | | | | | | | | | | | | | | Cum. | Cum. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | Avg | avg | prop. |
| 31-May | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 3 | 8 | 6 | 1 | 0 | 0 | 3 | 2 | 2 | 2 | 0.001 |
| 01-Jun | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 2 | 1 | 1 | 3 | 0.001 |
| 02-Jun | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 3 | 0 | 10 | 1 | 0 | 0 | 2 | 1 | 1 | 4 | 0.001 |
| 03-Jun | 0 | 1 | 0 | 0 | 6 | 0 | 0 | 3 | 0 | 7 | 0 | 0 | 6 | 0 | 0 | 2 | 5 | 0.002 |
| 04-Jun | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 3 | 1 | 0 | 1 | 0 | 0 | 0 | 2 | 1 | 6 | 0.002 |
| 05-Jun | 0 | 2 | 0 | 0 | 3 | 0 | 1 | 0 | 4 | 0 | 0 | 0 | 4 | 1 | 1 | 1 | 7 | 0.002 |
| 06-Jun | 0 | 0 | 1 | 0 | 11 | 0 | 2 | 1 | 1 | 3 | 0 | 0 | 1 | 2 | 0 | 1 | 9 | 0.003 |
| 07-Jun | 0 | 0 | 4 | 0 | 2 | 0 | 3 | 18 | 2 | 7 | 0 | 0 | 1 | 0 | 0 | 2 | 11 | 0.004 |
| 08-Jun | 0 | 0 | 0 | 0 | 5 | 0 | 9 | 1 | 3 | 13 | 0 | 0 | 3 | 2 | 0 | 2 | 14 | 0.004 |
| 09-Jun | 0 | 0 | 3 | 0 | 11 | 4 | 0 | 3 | 0 | 60 | 0 | 0 | 7 | 1 | 3 | 6 | 20 | 0.006 |
| 10-Jun | 0 | 0 | 0 | 3 | 6 | 3 | 7 | 2 | 5 | 1 | 0 | 0 | 13 | 11 | 3 | 4 | 23 | 0.007 |
| 11-Jun | 5 | 0 | 0 | 0 | 14 | 2 | 8 | 3 | 6 | 5 | 4 | 0 | 4 | 0 | 1 | 3 | 27 | 0.008 |
| 12-Jun | 0 | 0 | 0 | 4 | 21 | 4 | 15 | 0 | 0 | 11 | 12 | 0 | 7 | 2 | 6 | 5 | 32 | 0.010 |
| 13-Jun | 9 | 0 | 4 | 1 | 19 | 5 | 0 | 1 | 5 | 17 | 144 | 17 | 19 | 0 | 0 | 16 | 48 | 0.015 |
| 14-Jun | 0 | 0 | 5 | 0 | 25 | 42 | 1 | 164 | 53 | 58 | 49 | 5 | 62 | 3 | 5 | 31 | 80 | 0.025 |
| 15-Jun | 2 | 1 | 12 | 3 | 65 | 30 | 33 | 127 | 24 | 22 | 0 | 23 | 76 | 7 | 16 | 29 | 109 | 0.034 |
| 16-Jun | 1 | 0 | 0 | 2 | 14 | 13 | 55 | 170 | 14 | 71 | 0 | 7 | 99 | 1 | 42 | 33 | 142 | 0.044 |
| 17-Jun | 1 | 11 | 21 | 1 | 34 | 15 | 47 | 89 | 14 | 4 | 23 | 0 | 102 | 8 | 3 | 25 | 167 | 0.052 |
| 18-Jun | 2 | 3 | 20 | 2 | 5 | 99 | 22 | 174 | 45 | 0 | 7 | 13 | 182 | 18 | 17 | 41 | 207 | 0.065 |
| 19-Jun | 9 | 32 | 114 | 10 | 38 | 17 | 25 | 77 | 87 | 90 | 3 | 4 | 86 | 5 | 2 | 40 | 247 | 0.077 |
| 20-Jun | 12 | 11 | 0 | 54 | 35 | 164 | 62 | 564 | 258 | 142 | 3 | 27 | 79 | 8 | 81 | 100 | 347 | 0.109 |
| 21-Jun | 3 | 30 | 49 | 27 | 113 | 7 | 133 | 43 | 88 | 67 | 124 | 137 | 45 | 2 | 42 | 61 | 408 | 0.128 |
| 22-Jun | 9 | 4 | 1 | 47 | 29 | 83 | 84 | 64 | 19 | 23 | 452 | 56 | 11 | 12 | 56 | 63 | 471 | 0.148 |
| 23-Jun | 0 | 16 | 33 | 8 | 33 | 84 | 315 | 10 | 69 | 165 | 44 | 131 | 24 | 41 | 28 | 67 | 538 | 0.169 |
| 24-Jun | 7 | 23 | 8 | 78 | 55 | 128 | 24 | 148 | 20 | 27 | 54 | 33 | 22 | 26 | 83 | 49 | 587 | 0.184 |
| 25-Jun | 4 | 62 | 31 | 115 | 27 | 24 | 119 | 444 | 170 | 14 | 2 | 48 | 48 | 18 | 45 | 78 | 665 | 0.208 |
| 26-Jun | 11 | 9 | 129 | 27 | 77 | 174 | 115 | 91 | 33 | 113 | 25 | 19 | 32 | 7 | 7 | 58 | 723 | 0.227 |
| 27-Jun | 12 | 47 | 16 | 39 | 69 | 198 | 43 | 438 | 97 | 250 | 62 | 14 | 30 | 17 | 49 | 92 | 815 | 0.255 |
| 28-Jun | 26 | 89 | 88 | 36 | 197 | 114 | 49 | 37 | 136 | 187 | 46 | 186 | 40 | 2 | 92 | 88 | 903 | 0.283 |
| 29-Jun | 54 | 21 | 24 | 110 | 70 | 91 | 193 | 80 | 64 | 362 | 102 | 148 | 116 | 3 | 70 | 101 | 1,004 | 0.315 |
| 30-Jun | 41 | 40 | 9 | 72 | 56 | 173 | 464 | 42 | 134 | 113 | 50 | 40 | 77 | 86 | 60 | 97 | 1,101 | 0.345 |
| 01-Jul | 3 | 33 | 13 | 37 | 42 | 187 | 15 | 127 | 121 | 50 | 55 | 104 | 272 | 47 | 48 | 77 | 1,178 | 0.369 |
| 02-Jul | 20 | 63 | 13 | 45 | 12 | 16 | 84 | 162 | 92 | 3 | 103 | 65 | 195 | 54 | 48 | 65 | 1,243 | 0.390 |
| 03-Jul | 13 | 50 | 51 | 200 | 4 | 192 | 263 | 322 | 172 | 131 | 181 | 129 | 236 | 38 | 36 | 135 | 1,378 | 0.432 |
| 04-Jul | 7 | 84 | 51 | 22 | 42 | 151 | 101 | 265 | 83 | 119 | 33 | 145 | 38 | 9 | 32 | 79 | 1,456 | 0.456 |
| 05-Jul | 2 | 48 | 6 | 0 | 21 | 56 | 490 | 476 | 144 | 240 | 14 | 105 | 2 | 15 | 61 | 112 | 1,568 | 0.491 |
| 06-Jul | 4 | 3 | 0 | 55 | 27 | 233 | 47 | 208 | 127 | 72 | 254 | 146 | 45 | 120 | 94 | 96 | 1,664 | 0.521 |
| 07-Jul | 23 | 65 | 13 | 69 | 103 | 169 | 104 | 415 | 273 | 71 | 42 | 48 | 51 | 38 | 197 | 112 | 1,776 | 0.557 |
| 08-Jul | 21 | 46 | 12 | 34 | 72 | 244 | 90 | 317 | 93 | 48 | 144 | 68 | 184 | 53 | 88 | 101 | 1,877 | 0.588 |
| 09-Jul | 9 | 70 | 82 | 91 | 42 | 176 | 9 | 251 | 240 | 21 | 149 | 27 | 49 | 75 | 38 | 89 | 1,966 | 0.616 |
| 10-Jul | 24 | 173 | 48 | 46 | 36 | 71 | 79 | 143 | 137 | 67 | 37 | 78 | 189 | 11 | 7 | 76 | 2,042 | 0.640 |
| 11-Jul | 17 | 55 | 6 | 16 | 29 | 135 | 128 | 51 | 95 | 195 | 150 | 27 | 11 | 34 | 24 | 65 | 2,107 | 0.660 |
| 12-Jul | 70 | 61 | 1 | 40 | 65 | 153 | 106 | 319 | 50 | 844 | 727 | 8 | 37 | 0 | 28 | 167 | 2,274 | 0.713 |
| 13-Jul | 38 | 47 | 15 | 66 | 48 | 23 | 85 | 358 | 75 | 131 | 266 | 154 | 16 | 61 | 66 | 97 | 2,371 | 0.743 |
| 14-Jul | 20 | 53 | 2 | 48 | 34 | 98 | 81 | 91 | 101 | 63 | 422 | 74 | 100 | 92 | 29 | 87 | 2,458 | 0.770 |
| 15-Jul | 7 | 21 | 51 | 37 | 49 | 89 | 111 | 232 | 170 | 56 | 323 | 82 | 18 | 41 | 11 | 87 | 2,545 | 0.797 |

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**Appendix B8.–**Page 2 of 2.

| | Year | | | | | | | | | | | | | | | | Cum. | Cum. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | Avg | avg | prop. |
| 16-Jul | 11 | 15 | 178 | 21 | 19 | 101 | 27 | 100 | 113 | 107 | 503 | 73 | 11 | 55 | 94 | 95 | 2,640 | 0.827 |
| 17-Jul | 16 | 26 | 13 | 38 | 33 | 13 | 11 | 257 | 116 | 48 | 30 | 27 | 104 | 21 | 2 | 50 | 2,690 | 0.843 |
| 18-Jul | 27 | 102 | 5 | 18 | 146 | 19 | 72 | 118 | 142 | 96 | 228 | 1 | 18 | 39 | 76 | 74 | 2,764 | 0.866 |
| 19-Jul | 39 | 91 | 3 | 25 | 0 | 92 | 73 | 64 | 39 | 45 | 71 | 27 | 18 | 34 | 0 | 41 | 2,805 | 0.879 |
| 20-Jul | 20 | 74 | 33 | 17 | 10 | 24 | 229 | 120 | 38 | 134 | 31 | 51 | 9 | 25 | 7 | 55 | 2,860 | 0.896 |
| 21-Jul | 14 | 57 | 37 | 35 | 2 | 51 | 16 | 16 | 20 | 88 | 11 | 15 | 23 | 20 | 1 | 27 | 2,887 | 0.905 |
| 22-Jul | 0 | 1 | 22 | 7 | 6 | 49 | 20 | 59 | 29 | 38 | 127 | 12 | 88 | 38 | 1 | 33 | 2,920 | 0.915 |
| 23-Jul | 228 | 15 | 19 | 1 | 12 | 43 | 27 | 17 | 8 | 38 | 31 | 30 | 27 | 16 | 10 | 35 | 2,955 | 0.926 |
| 24-Jul | 4 | 0 | 8 | 0 | 4 | 30 | 31 | 47 | 34 | 38 | 68 | 2 | 4 | 5 | 26 | 20 | 2,975 | 0.932 |
| 25-Jul | 53 | 24 | 8 | 1 | 13 | 23 | 35 | 381 | 18 | 12 | 6 | 4 | 19 | 4 | 3 | 40 | 3,015 | 0.945 |
| 26-Jul | 4 | 16 | 1 | 4 | 4 | 27 | 35 | 32 | 13 | 98 | 13 | 2 | 21 | 8 | 7 | 19 | 3,034 | 0.951 |
| 27-Jul | 81 | 39 | 7 | 1 | 2 | 17 | 25 | 30 | 5 | 60 | 19 | 8 | 14 | 4 | 3 | 21 | 3,055 | 0.957 |
| 28-Jul | 2 | 39 | 1 | | 5 | 12 | 83 | 52 | 14 | 75 | 33 | 123 | 14 | 7 | 1 | 31 | 3,086 | 0.967 |
| 29-Jul | 1 | 28 | | | 0 | 21 | 3 | 26 | 16 | 11 | 24 | 132 | 13 | 1 | 0 | 18 | 3,105 | 0.973 |
| 30-Jul | 43 | 3 | | | 12 | 5 | 65 | 192 | 21 | 23 | 2 | 18 | 13 | 1 | 0 | 27 | 3,131 | 0.981 |
| 31-Jul | 0 | 4 | | | 17 | 10 | 3 | 69 | 19 | 4 | 3 | 7 | 21 | 1 | 2 | 11 | 3,142 | 0.985 |
| 01-Aug | 9 | 2 | | | 10 | 17 | 13 | 44 | 31 | 15 | 10 | 6 | 8 | 0 | 4 | 11 | 3,153 | 0.988 |
| 02-Aug | 12 | 4 | | | 1 | 32 | 4 | 7 | 73 | 16 | 5 | 1 | 7 | 0 | 0 | 11 | 3,164 | 0.991 |
| 03-Aug | 3 | 4 | | | 1 | 18 | 7 | 60 | 25 | 42 | 3 | 7 | 4 | 1 | 3 | 12 | 3,176 | 0.995 |
| 04-Aug | 4 | 19 | | | 3 | 11 | 15 | | 13 | 21 | 0 | 3 | 4 | 0 | 3 | 6 | 3,182 | 0.997 |
| 05-Aug | 0 | 5 | | | 4 | 9 | | | 14 | 11 | 1 | 1 | 4 | 1 | 2 | 3 | 3,186 | 0.998 |
| 06-Aug | 4 | 2 | | | | | | | 17 | 10 | 0 | 3 | 5 | 1 | 2 | 3 | 3,188 | 0.999 |
| 07-Aug | 0 | 0 | | | | | | | | 10 | 0 | | 3 | 0 | 0 | 1 | 3,189 | 0.999 |
| 08-Aug | 0 | 2 | | | | | | | | | | | 1 | 1 | 0 | 0 | 3,190 | 1.000 |
| 09-Aug | 1 | 1 | | | | | | | | | | | | | 0 | 0 | 3,190 | 1.000 |
| 10-Aug | 0 | 0 | | | | | | | | | | | | | 0 | 0 | 3,190 | 1.000 |
| 11-Aug | 0 | 0 | | | | | | | | | | | | | 0 | 0 | 3,190 | 1.000 |
| 12-Aug | 0 | 0 | | | | | | | | | | | | | 0 | 0 | 3,190 | 1.000 |
| 13-Aug | 2 | 2 | | | | | | | | | | | | | 0 | 0 | 3,190 | 1.000 |
| 14-Aug | 1 | 1 | | | | | | | | | | | | | 0 | 0 | 3,190 | 1.000 |
| 15-Aug | 0 | 1 | | | | | | | | | | | | | 0 | 0 | 3,190 | 1.000 |
| 16-Aug | 0 | 1 | | | | | | | | | | | | | 0 | 0 | 3,190 | 1.000 |
| 17-Aug | 2 | 0 | | | | | | | | | | | | | 0 | 0 | 3,190 | 1.000 |
| 18-Aug | 1 | | | | | | | | | | | | | | 0 | 0 | 3,190 | 1.000 |
| 19-Aug | 4 | | | | | | | | | | | | | | | 0 | 3,191 | 1.000 |
| 20-Aug | 4 | | | | | | | | | | | | | | | 0 | 3,191 | 1.000 |
| 21-Aug | 2 | | | | | | | | | | | | | | | 0 | 3,191 | 1.000 |
| Weir total | 1,078 | 1,852 | 1,274 | 1,613 | 1,985 | 4,091 | 4,416 | 8,231 | 4,151 | 5,001 | 5,329 | 2,721 | 3,092 | 1,261 | 1,772 | 3,191 | | |
| Add-on number | | | | | | 109 | | | | | | | | | | | | |
| Estimated total | 1,078 | 1,852 | 1,274 | 1,613 | 1,985 | 4,200 | 4,416 | 8,231 | 4,151 | 5,001 | 5,329 | 2,721 | 3,092 | 1,261 | 1,772 | 3,350 | | |

[a] In 1993, 109 large Chinook were counted below the weir on the day it was removed, and were added to the weir count. In 1988, small Chinook were not counted.

# APPENDIX C:
# ESTIMATED SPORT FISHERY HARVESTS AND SPAWNER ABUNDANCE

**Appendix C1.–**Chinook Salmon Harvest in Situk River.

An active sport fishery harvests Chinook salmon in the Situk River. Road access to the Situk River for sport fishing occurs at the Lower Landing near the Situk-Ahrnklin Inlet and upstream about 12.5 miles at Nine Mile Bridge on Forest Highway 10. Anglers fish from banks or boats after accessing the river. Some travel by boat from the upper access point and exit at the Lower Landing.

Sport fishing is not allowed above Nine Mile Bridge and was not allowed between Nine Mile Bridge and the upper weir site. Hence, from 1976-1987 the weir counts included all fishing harvest prior to spawning.

When the weir was moved to the lower river site, the estimated recreational harvest above the weir must be subtracted from weir counts to estimate spawning escapement. The recreational harvest of Chinook salmon in the Situk River is estimated through a statewide postal survey; this program started in 1977. Annual estimates are available in published reports (e.g.Howe et al. 2001b). In 1996 the statewide postal survey was reconfigured to estimate harvests of salmon above and below the lower river site. In addition, an on-site creel project was operated in 1985-1988 and again in recent years. We used the statewide postal survey estimates for 1977-1985 and 1990-2000 and the on-site creel estimates in 1985-1988 and 2001-2003 (Johnson 2005) to estimate returns (Appendix C1). We used the 1989-2000 postal survey estimates and the 1988 and 2001-2003 on-site creel survey estimates to estimate spawning abundance, by subtracting estimates of the recreational harvest above the weir from the weir counts (Appendix C2).

For the period 1977-2003, the estimated recreational harvest of Chinook salmon in the Situk River has ranged from 0 (zero) large and medium-sized fish in 1986, 1989 and 1990 (fishery closed) to 1,598 large and medium-sized fish in 1997. The recreational fishery harvests were 400 or fewer large and medium-sized Chinook through 1994, then were above 1,000 fish from 1995 to 2000. Since 1988, the estimated removals in the sport fishery above the weir have ranged from 0 (zero) in 1989 and 1990 to 812 in 1997.

**Appendix C2.–**Estimated recreational harvests of Chinook salmon in the Situk River, in total and above the Situk River Weir, 1976-2003, with (standard errors).

| | Estimated total harvest [a, c, d] | | | | | | Estimated harvest above the Situk Weir [b, e] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Small Fish | | Med/Large Fish | | Total | | Small Fish | | Med/Large Fish | | Total | | Large fish [f] | |
| Year | Harvest | SE | Harvest | | Harvest | SE | Harvest | SE | Harvest | SE | Harvest | SE | Harvest | SE |
| 1976 | 0 | (0) | 200 | (50) | 200 | (50) | 0 | (0) | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | (0) | 244 | (61) | 244 | (61) | 0 | (0) | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | (0) | 210 | (53) | 210 | (53) | 0 | (0) | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | (0) | 282 | (71) | 282 | (71) | 0 | (0) | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | (0) | 353 | (88) | 353 | (88) | 0 | (0) | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 11 | (11) | 130 | (33) | 141 | (34) | 0 | (0) | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | (0) | 63 | (16) | 63 | (16) | 0 | (0) | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 10 | (10) | 42 | (11) | 52 | (15) | 0 | (0) | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 5 | (5) | 146 | (37) | 151 | (37) | 0 | (0) | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 217 | (109) | 294 | (74) | 511 | (131) | 0 | (0) | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 37 | (37) | 0 | (0) | 37 | (37) | 0 | (0) | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 319 | (160) | 75 | (19) | 394 | (161) | 0 | (0) | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 3 | (3) | 185 | (54) | 188 | (54) | 0 | (0) | 56 | (28) | 56 | (28) | 17 | (17) |
| 1989 | 0 | (0) | 0 | (0) | 0 | 0 | 0 | (0) | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 68 | (66) | 0 | (0) | 68 | (66) | 0 | (0) | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 8 | (8) | 88 | (44) | 96 | (49) | 2 | (2) | 26 | (26) | 29 | (27) | 8 | (8) |
| 1992 | 9 | (9) | 172 | (35) | 181 | (50) | 3 | (3) | 52 | (52) | 54 | (52) | 23 | (23) |
| 1993 | 115 | (58) | 137 | (36) | 252 | (77) | 92 | (46) | 41 | (41) | 133 | (62) | 28 | (28) |
| 1994 | 167 | (85) | 400 | (57) | 567 | (102) | 50 | (25) | 120 | (60) | 170 | (65) | 40 | (40) |
| 1995 | 279 | (84) | 1,407 | (257) | 1,686 | (280) | 84 | (42) | 422 | (211) | 506 | (215) | 370 | (185) |
| 1996 | 1,283 | (343) | 1,529 | (257) | 2,812 | (505) | 568 | (234) | 482 | (134) | 1,050 | (310) | 375 | (187) |
| 1997 | 630 | (200) | 1,598 | (267) | 2,228 | (373) | 467 | (191) | 960 | (228) | 1,427 | (341) | 812 | (197) |
| 1998 | 660 | (192) | 1,156 | (246) | 1,816 | (353) | 405 | (143) | 635 | (193) | 1,040 | (266) | 429 | (132) |
| 1999 | 385 | (139) | 1,160 | (224) | 1,545 | (270) | 150 | (96) | 598 | (186) | 748 | (214) | 486 | (152) |
| 2000 | 378 | (121) | 1,143 | (180) | 1,521 | (227) | 211 | (101) | 793 | (155) | 1,004 | (192) | 733 | (144) |
| 2001 | 330 | (100) | 75 | (19) | 405 | (102) | 300 | (100) | 45 | (16) | 345 | (101) | 40 | (16) |
| 2002 | 30 | (10) | 99 | (21) | 129 | (34) | 18 | (7) | 48 | (18) | 66 | (20) | 24 | (12) |
| 2003 | 141 | (32) | 909 | (97) | 1,050 | (119) | 108 | (27) | 528 | (69) | 636 | (74) | 498 | (68) |
| Averages | | | | | | | | | | | | | | |
| 1976-2003 | 182 | | 432 | | 614 | | 88 | | 172 | | 259 | | 139 | |
| 1976-1988 | 46 | | 171 | | 217 | | 0 | | 4 | | 4 | | 1 | |
| 1989-2003 | 299 | | 658 | | 957 | | 164 | | 317 | | 481 | | 258 | |

[a] Estimates of total harvest are from the Statewide Harvest Survey (SWHS), except for 1985-1988 and 2001, when on-site creel estimates were available.
[b] All recreational harvests up through 1987 occurred below the Situk Weir, which was located just below Nine Mile Bridge from 1976-1988.
[c] The harvest in 1976 was estimated from the average for 1977-1982.
[d] The recreational fishery was closed in 1986, 1989 and 1990 for retention of medium/large fish, but was open in 1986 and 1990 for retention of small fish.
[e] The SWHS provided direct estimates of the total harvest and harvest above and below the weir from 1996-2000, as did the on-site creel in 2001.
In 1988 and 1991-1995 we estimated that 30% of the recreational harvest of medium/large fish occurred above the weir, from on-site interviews, and estimated 80% in 1993.
[f] In 1992-1994 the SWHS supplied direct estimates of large fish. In 1997-2001 samples taken from the on-site creel program were used to estimate the number of large fish taken.
In 1988 and 1991 the average percent large for 1992-1994 was used to estimate the large harvest above the weir.
In 1995 and 1996 the average percent large for 1997-2001 was used to estimate the large harvest above the weir.

**Appendix C3.–**Weir counts, sport removals and estimated spawners of medium and large-sized Chinook salmon in the Situk River, 1976-2003.

| | Situk River weir counts | | | Harvests above weir [a] | | | Estimate spawning abundance | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Small Chinook | Medium Chinook | Large Chinook | Small Chinook | Medium Chinook | Large Chinook | Small Chinook | Medium Chinook | Large Chinook | SE large | Lg+Medium Chinook | Total |
| 1976 | NE | 520 | 1,421 | 0 | 0 | 0 | NE | 520 | 1,421 | 0 | 1,941 | |
| 1977 | NE | 148 | 1,732 | 0 | 0 | 0 | NE | 148 | 1,732 | 0 | 1,880 | |
| 1978 | NE | 295 | 808 | 0 | 0 | 0 | NE | 295 | 808 | 0 | 1,103 | |
| 1979 | NE | 470 | 1,284 | 0 | 0 | 0 | NE | 470 | 1,284 | 0 | 1,754 | |
| 1980 | NE | 220 | 905 | 0 | 0 | 0 | NE | 220 | 905 | 0 | 1,125 | |
| 1981 | NE | 105 | 702 | 0 | 0 | 0 | NE | 105 | 702 | 0 | 807 | |
| 1982 | NE | 177 | 434 | 0 | 0 | 0 | NE | 177 | 434 | 0 | 611 | |
| 1983 | NE | 257 | 592 | 0 | 0 | 0 | NE | 257 | 592 | 0 | 849 | |
| 1984 | NE | 475 | 1,726 | 0 | 0 | 0 | NE | 475 | 1,726 | 0 | 2,201 | |
| 1985 | NE | 461 | 1,521 | 0 | 0 | 0 | NE | 461 | 1,521 | 0 | 1,982 | |
| 1986 | NE | 505 | 2,067 | 0 | 0 | 0 | NE | 505 | 2,067 | 0 | 2,572 | |
| 1987 | NE | 505 | 1,379 | 0 | 0 | 0 | NE | 505 | 1,379 | 0 | 1,884 | |
| 1988 | NE | 193 | 885 | 0 | 39 | 17 | NE | 154 | 868 | (17) | 1,022 | |
| 1989 | 972 | 243 | 637 | 0 | 0 | 0 | 972 | 243 | 637 | 0 | 880 | 1,852 |
| 1990 | 147 | 499 | 628 | 0 | 0 | 0 | 147 | 499 | 628 | 0 | 1,127 | 1,274 |
| 1991 | 584 | 132 | 897 | 2 | 18 | 8 | 582 | 114 | 889 | (8) | 1,003 | 1,585 |
| 1992 | 131 | 236 | 1,618 | 3 | 29 | 23 | 128 | 207 | 1,595 | (23) | 1,802 | 1,930 |
| 1993 | 2,730 | 490 | 980 | 92 | 13 | 28 | 2,638 | 477 | 952 | (28) | 1,429 | 4,067 |
| 1994 | 1,634 | 1,471 | 1,311 | 50 | 80 | 40 | 1,584 | 1,391 | 1,271 | (40) | 2,662 | 4,246 |
| 1995 | 2,914 | 617 | 4,700 | 84 | 52 | 370 | 2,830 | 565 | 4,330 | (185) | 4,895 | 7,725 |
| 1996 | 1,374 | 602 | 2,175 | 568 | 107 | 375 | 806 | 495 | 1,800 | (187) | 2,295 | 3,101 |
| 1997 | 1,729 | 582 | 2,690 | 467 | 148 | 812 | 1,262 | 434 | 1,878 | (197) | 2,312 | 3,574 |
| 1998 | 3,125 | 851 | 1,353 | 405 | 206 | 429 | 2,720 | 645 | 924 | (132) | 1,569 | 4,289 |
| 1999 | 473 | 301 | 1,947 | 150 | 112 | 486 | 323 | 189 | 1,461 | (152) | 1,650 | 1,973 |
| 2000 | 413 | 161 | 2,518 | 211 | 60 | 733 | 202 | 101 | 1,785 | (144) | 1,886 | 2,088 |
| 2001 | 463 | 102 | 696 | 300 | 5 | 40 | 163 | 97 | 656 | (16) | 753 | 916 |
| 2002 | 300 | 448 | 1,024 | 18 | 24 | 24 | 282 | 424 | 1,000 | (12) | 1,424 | 1,706 |
| 2003 | 334 | 329 | 2,615 | 108 | 30 | 498 | 226 | 299 | 2,117 | (68) | 2,416 | 2,642 |
| Averages | | | | | | | | | | | | |
| 1976-1988 | | 333 | 1,189 | 0 | 3 | 1 | | 330 | 1,188 | | 1,518 | |
| 1989-2003 | 1,155 | 471 | 1,719 | 164 | 59 | 258 | 991 | 412 | 1,462 | | 1,874 | 2,865 |

[a] Recreational harvest estimates above the weir in 2002 are unavailable at the time of publication.

Partial estimates of small (age-.1) Chinook are included.

# APPENDIX D:
# ESTIMATES OF AGE COMPOSITION OF CHINOOK SALMON IN HARVESTS AND ESCAPEMENTS

**Appendix D1.-**Estimates of age composition of Chinook salmon in harvests and escapements.

Age compositions of Chinook salmon in the commercial set gillnet and subsistence fisheries were estimated from scale samples taken in the commercial gillnet fishery. Because samples from the commercial gillnet fishery were systematically drawn, resulting estimates were considered representative of the total harvest in that fishery. Since the timing and gear in these two fisheries is nearly the same, the samples taken from the commercial fishery should be representative of both.

In the set gillnet/subsistence fishery, the numbers of fish harvested by age and the associated variance is estimated from the notation given earlier in the main body of this report.

Scale samples to estimate age composition were not collected in the commercial fishery prior to 1982 and in 1989 (Appendix D1). Average age distribution in the commercial gillnet fishery for 1982-1988 and 1990-2001 was used to estimate the age composition of the net harvest in 1980, 1981 and 1989.

Age composition of Chinook salmon in the recreational fishery was a result of the estimated harvest and sampling for age. Estimated age composition and its estimated variance were calculated from notation given earlier.

Scale samples to estimate age composition were not collected in the recreational fishery in 1980, 1981 and in 1984-1996 (Appendix D2). The sport fishery was closed in 1986, 1989 and 1990. For 1980 and 1981 the average age distribution in the recreational fishery for 1982-1983 and 1997-2001 was used to estimate the age composition. In 1984, 1985, 1987, 1988 and 1991-1996 the age distribution from the commercial gillnet samples in each year was used to estimate age composition of the recreational harvest of medium and large Chinook salmon.

Because samples in the gillnet were systematically drawn, and because age composition of medium and large fish harvested in both the gillnet and recreational fisheries are similar for 1997-2001 (see below), using gillnet samples for the above mentioned years were considered the best representative age distribution for the recreational fishery in years without age sampling.

**Comparison of age distribution in the gillnet (GN) and recreational fishery (REC) , 1997-2003.**

| Year | Gear | 0.2 | 0.3 | 0.4 | 1.3 | n |
|---|---|---|---|---|---|---|
| 1997 | GN | 18.8% | 37.8% | 37.6% | 3.3% | 430 |
| | REC | 24.7% | 54.0% | 16.3% | 1.7% | 177 |
| 1998 | GN | 34.0% | 43.5% | 19.1% | 1.7% | 436 |
| | REC | 28.0% | 51.1% | 15.4% | 1.1% | 182 |
| 1999 | GN | 23.6% | 59.2% | 11.1% | 2.7% | 446 |
| | REC | 19.2% | 65.5% | 11.5% | 1.7% | 287 |
| 2000 | GN | 6.7% | 72.2% | 13.4% | 3.3% | 418 |
| | REC | 8.4% | 64.7% | 9.8% | 12.6% | 215 |
| 2001 | GN | 16.4% | 23.5% | 41.7% | 12.2% | 346 |
| | REC | 6.3% | 21.9% | 65.6% | 6.3% | 32 |
| 2002 | GN | 40.6% | 19.8% | 2.8% | 5.9% | 395 |
| | REC | 48.1% | 37.0% | 7.4% | 0.0% | 27 |
| 2003 | GN | 7.5% | 77.3% | 6.8% | 4.3% | 416 |
| | REC | 7.8% | 78.4% | 2.8% | 6.9% | 218 |

Age compositions of Chinook salmon in the escapement were estimated from scale samples taken from the trap at the Situk Weir (Appendix D3). Because the weir nor the trap is "fish-tight" for age-.1 fish, samples from the weir were stratified separately to counts of age-.1 fish vs. those aged -.2-.5. Note that small fish were not used in the spawner-recruit analysis, whether from the escapement or harvest.

Estimated harvest by age by year is shown for the gillnet fisheries in Appendix D4 and for the recreational fishery in Appendix D5. Estimated escapement by age by year is shown in Appendix D6. The estimated total run by age by year is shown in Appendix D7 and the associated SEs in Appendix D8. The estimated percents by age and year are shown in Appendix D9 (age-.2-.5 fish) and Appendix D10 (age-.1-.5 fish).

**Appendix D2.–**Sample size $m_t$ and samples by age class $m_{at}$ of Situk River Chinook salmon harvested in the commercial set gillnet fishery, 1982-2003. [a]

| Year | 0.1 | 0.2 | 1.1 | 0.3 | 1.2 | 0.4 | 1.3 | 0.5 | 1.4 | 1.5 | $m_t$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | | 3 | | 5 | 2 | 5 | | | 3 | | 18 |
| 1983 | | 45 | | 90 | 30 | 26 | 28 | | 1 | | 220 |
| 1984 | | 1 | | 19 | 2 | 3 | 19 | | 5 | | 49 |
| 1985 | | 11 | | 24 | 13 | 15 | 16 | 1 | 20 | 1 | 101 |
| 1986 | | 7 | | 12 | 9 | 9 | 13 | | 12 | | 62 |
| 1987 | | 2 | | 29 | 1 | 8 | 25 | | 8 | | 73 |
| 1988 | | 1 | | 2 | 4 | 14 | 3 | | 7 | | 31 |
| 1989 | | | | | | | | | | | 0 |
| 1990 | | 29 | | 9 | 19 | 27 | 7 | | 17 | | 108 |
| 1991 | 1 | 60 | 1 | 170 | 27 | 28 | 32 | 2 | 9 | 1 | 331 |
| 1992 | | 19 | 1 | 17 | 5 | 40 | 7 | | 13 | | 102 |
| 1993 | | 48 | 6 | 84 | 34 | 67 | 32 | 4 | 42 | 1 | 318 |
| 1994 | | 80 | 1 | 58 | 32 | 42 | 8 | | 11 | | 232 |
| 1995 | | 22 | 1 | 288 | 11 | 33 | 51 | | 1 | | 407 |
| 1996 | | 52 | 1 | 151 | 21 | 132 | 43 | 2 | 24 | | 426 |
| 1997 | 2 | 80 | 2 | 161 | 4 | 160 | 14 | 2 | 5 | | 430 |
| 1998 | 8 | 144 | 5 | 184 | 6 | 81 | 7 | | 1 | | 436 |
| 1999 | 1 | 104 | 4 | 261 | 11 | 49 | 12 | 1 | 3 | | 446 |
| 2000 | | 28 | | 302 | 16 | 56 | 14 | | 2 | | 418 |
| 2001 | 4 | 55 | 6 | 79 | 7 | 140 | 41 | 2 | 12 | | 346 |
| 2002 | | 158 | 6 | 77 | 113 | 11 | 23 | | 7 | | 395 |
| 2003 | 2 | 31 | | 320 | 15 | 28 | 18 | | 2 | | 416 |

[a] Age-.1 fish (age classes 0.1 and 1.1) were excluded from the spawner-recruit analysis.

**Appendix D3.–**Sample size $m_t$ and samples by age class $m_{at}$ of Situk River Chinook salmon harvested in the recreational fishery, 1982-2003. [a]

| Year | 0.1 | 0.2 | 1.1 | 0.3 | 1.2 | 0.4 | 1.3 | 0.5 | 1.4 | 1.5 | $m_t$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | | 9 | | 22 | 5 | 5 | 5 | | 8 | 1 | 55 |
| 1983 | 3 | 4 | | 4 | 3 | 1 | 1 | | | | 16 |
| 1997 | 63 | 44 | 8 | 96 | 2 | 29 | 3 | 2 | | 1 | 248 |
| 1998 | 10 | 51 | 2 | 93 | 8 | 28 | 2 | | | | 194 |
| 1999 | 18 | 55 | | 188 | 1 | 33 | 5 | | 5 | | 305 |
| 2000 | 32 | 18 | 1 | 139 | 4 | 21 | 27 | | 6 | | 248 |
| 2001 | 55 | 2 | 2 | 7 | | 21 | 2 | | | | 89 |
| 2002 | 8 | 13 | | 10 | 2 | 2 | | | | | 35 |
| 2003 | 21 | 17 | 2 | 171 | 5 | 6 | 15 | | 4 | | 241 |

[a] Age-.1 fish (age classes 0.1 and 1.1) were excluded from the spawner-recruit analysis. No samples were collected in 1984-1996. The recreational fishery was closed in 1986, 1989 and 1990.

**Appendix D4.–**Sample size $m_t$ and samples by age class $m_{at}$ of Chinook salmon passing the counting weir on the Situk River, 1984-2003. [a]

| Year | 0.1 | 0.2 | 1.1 | 0.3 | 1.2 | 0.4 | 1.3 | 0.5 | 1.4 | 1.5 | $m_t$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1984 | 11 | 7 | 2 | 35 | 11 | 29 | 26 | 1 | 5 | | 127 |
| 1988 | | 1 | | 5 | 6 | 30 | 2 | | 19 | | 63 |
| 1990 | 7 | 37 | 3 | 16 | 8 | 25 | 5 | | 13 | | 114 |
| 1991 | 16 | 19 | | 31 | 9 | 2 | 2 | | 2 | | 81 |
| 1992 | 13 | 7 | 2 | 21 | 2 | 40 | 3 | | 2 | | 90 |
| 1993 | 40 | 13 | 22 | 14 | 2 | 18 | 4 | 2 | 4 | | 119 |
| 1995 | 87 | 36 | 10 | 328 | 14 | 45 | 26 | 1 | 4 | | 551 |
| 1996 | 77 | 51 | 8 | 152 | 6 | 81 | 18 | 1 | 14 | | 408 |
| 1997 | 68 | 65 | 9 | 153 | 6 | 89 | 12 | 1 | 8 | | 411 |
| 1998 | 77 | 61 | 4 | 120 | 3 | 19 | 2 | | 3 | | 289 |
| 1999 | 12 | 32 | 6 | 145 | | 33 | 3 | | | | 231 |
| 2000 | 4 | 7 | 2 | 170 | 3 | 22 | 16 | | 1 | | 225 |
| 2001 | 8 | 20 | 1 | 19 | 2 | 51 | 1 | 1 | | | 103 |
| 2002 | 19 | 64 | 4 | 29 | 2 | 4 | 1 | | | | 123 |
| 2003 | 11 | 15 | 5 | 182 | 8 | 9 | 16 | | 1 | | 247 |

[a] Age-.1 fish (age classes 0.1 and 1.1) were excluded from the spawner-recruit analysis.

**Appendix D5.–**Estimated harvest by age class $\hat{H}_{at}$ of Situk River Chinook salmon harvested in the commercial set gillnet and subsistence fisheries, 1982-2003. [a]

| Year | 0.1 | 0.2 | 1.1 | 0.3 | 1.2 | 0.4 | 1.3 | 0.5 | 1.4 | 1.5 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 0 | 46 | 0 | 76 | 31 | 76 | 0 | 0 | 46 | 0 | 275 |
| 1983 | 0 | 82 | 0 | 163 | 54 | 47 | 51 | 0 | 2 | 0 | 399 |
| 1984 | 0 | 12 | 0 | 233 | 25 | 37 | 233 | 0 | 61 | 0 | 601 |
| 1985 | 0 | 70 | 0 | 152 | 82 | 95 | 101 | 6 | 127 | 6 | 640 |
| 1986 | 0 | 34 | 0 | 58 | 44 | 44 | 63 | 0 | 58 | 0 | 301 |
| 1987 | 0 | 25 | 0 | 363 | 13 | 100 | 313 | 0 | 100 | 0 | 915 |
| 1988 | 0 | 13 | 0 | 25 | 50 | 176 | 38 | 0 | 88 | 0 | 389 |
| 1989 | 0 | 78 | 0 | 175 | 37 | 109 | 57 | 0 | 42 | 0 | 497 |
| 1990 | 0 | 139 | 0 | 43 | 91 | 129 | 33 | 0 | 81 | 0 | 516 |
| 1991 | 3 | 182 | 3 | 516 | 82 | 85 | 97 | 6 | 27 | 3 | 1,004 |
| 1992 | 0 | 344 | 18 | 308 | 90 | 724 | 127 | 0 | 235 | 0 | 1,845 |
| 1993 | 0 | 150 | 19 | 262 | 106 | 209 | 100 | 12 | 131 | 3 | 992 |
| 1994 | 0 | 1,042 | 13 | 756 | 417 | 547 | 104 | 0 | 143 | 0 | 3,023 |
| 1995 | 0 | 469 | 21 | 6,146 | 235 | 704 | 1,088 | 0 | 21 | 0 | 8,685 |
| 1996 | 0 | 522 | 10 | 1,516 | 211 | 1,325 | 432 | 20 | 241 | 0 | 4,276 |
| 1997 | 13 | 501 | 13 | 1,008 | 25 | 1,001 | 88 | 13 | 31 | 0 | 2,691 |
| 1998 | 49 | 890 | 31 | 1,137 | 37 | 501 | 43 | 0 | 6 | 0 | 2,695 |
| 1999 | 10 | 1,026 | 39 | 2,574 | 108 | 483 | 118 | 10 | 30 | 0 | 4,398 |
| 2000 | 0 | 128 | 0 | 1,381 | 73 | 256 | 64 | 0 | 9 | 0 | 1,912 |
| 2001 | 17 | 237 | 26 | 340 | 30 | 602 | 176 | 9 | 52 | 0 | 1,489 |
| 2002 | 0 | 598 | 23 | 291 | 427 | 42 | 87 | 0 | 26 | 0 | 1,494 |
| 2003 | 14 | 219 | 0 | 2,263 | 106 | 198 | 127 | 0 | 14 | 0 | 2,942 |

[a] Age-.1 fish (age classes 0.1 and 1.1) were excluded from the spawner-recruit analysis.

**Appendix D6.–**Estimated harvest by age class $\hat{H}_{at}$ of Situk River Chinook salmon harvested in the recreational fishery, 1982-2003. [a]

| Year | 0.1 | 0.2 | 1.1 | 0.3 | 1.2 | 0.4 | 1.3 | 0.5 | 1.4 | 1.5 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 0 | 10 | 0 | 25 | 6 | 6 | 6 | 0 | 9 | 1 | 63 |
| 1983 | 10 | 13 | 0 | 13 | 10 | 3 | 3 | 0 | 0 | 0 | 52 |
| 1984 | 3 | 3 | 0 | 57 | 6 | 9 | 57 | 0 | 15 | 0 | 151 |
| 1985 | 195 | 32 | 22 | 70 | 38 | 44 | 47 | 3 | 58 | 3 | 511 |
| 1986 | 33 |  | 4 |  |  |  |  |  |  |  | 37 |
| 1987 | 287 | 2 | 32 | 30 | 1 | 8 | 26 | 0 | 8 | 0 | 394 |
| 1988 | 0 | 6 | 0 | 12 | 24 | 85 | 18 | 0 | 42 | 0 | 188 |
| 1989 |  |  |  |  |  |  |  |  |  |  | 0 |
| 1990 | 48 |  | 20 |  |  |  |  |  |  |  | 68 |
| 1991 | 8 | 16 | 0 | 45 | 7 | 7 | 9 | 1 | 2 | 0 | 96 |
| 1992 | 8 | 32 | 1 | 29 | 9 | 68 | 12 | 0 | 22 | 0 | 181 |
| 1993 | 74 | 21 | 41 | 37 | 15 | 29 | 14 | 2 | 18 | 0 | 252 |
| 1994 | 150 | 139 | 17 | 100 | 55 | 73 | 14 | 0 | 19 | 0 | 567 |
| 1995 | 250 | 76 | 29 | 998 | 38 | 114 | 177 | 0 | 3 | 0 | 1,686 |
| 1996 | 1,162 | 187 | 121 | 543 | 76 | 475 | 155 | 7 | 86 | 0 | 2,812 |
| 1997 | 566 | 395 | 72 | 862 | 18 | 261 | 27 | 18 | 0 | 9 | 2,228 |
| 1998 | 550 | 324 | 110 | 591 | 51 | 178 | 13 | 0 | 0 | 0 | 1,816 |
| 1999 | 385 | 222 | 0 | 760 | 4 | 133 | 20 | 0 | 20 | 0 | 1,545 |
| 2000 | 367 | 96 | 11 | 739 | 21 | 112 | 144 | 0 | 32 | 0 | 1,521 |
| 2001 | 250 | 9 | 9 | 32 | 0 | 96 | 9 | 0 | 0 | 0 | 405 |
| 2002 | 29 | 48 | 0 | 37 | 7 | 7 | 0 | 0 | 0 | 0 | 129 |
| 2003 | 91 | 74 | 9 | 745 | 22 | 26 | 65 | 0 | 17 | 0 | 1,050 |

[a] Age-.1 fish (age classes 0.1 and 1.1) were excluded from the spawner-recruit analysis. The recreational fishery was closed completely in 1989 and was closed to retention of fish > 16 inches total length in 1986 and 1990. The 2002 and 2003 estimates are preliminary estimates from the onsite creel program (B. Johnson, ADF&G, SFD, Yakutat, personal communication).

**Appendix D7.–**Estimated escapement by age class $\hat{S}_{at}$ of Situk River Chinook salmon, 1982-2003. [a]

| Year | 0.1 | 0.2 | 1.1 | 0.3 | 1.2 | 0.4 | 1.3 | 0.5 | 1.4 | 1.5 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 0 | 100 | 0 | 244 | 56 | 56 | 56 | 0 | 89 | 11 | 611 |
| 1983 | 0 | 174 | 0 | 347 | 116 | 100 | 108 | 0 | 4 | 0 | 849 |
| 1984 | 191 | 121 | 35 | 607 | 191 | 503 | 451 | 17 | 87 | 0 | 2,201 |
| 1985 | 0 | 216 | 0 | 471 | 255 | 294 | 314 | 20 | 392 | 20 | 1,982 |
| 1986 | 0 | 290 | 0 | 498 | 373 | 373 | 539 | 0 | 498 | 0 | 2,572 |
| 1987 | 0 | 52 | 0 | 748 | 26 | 206 | 645 | 0 | 206 | 0 | 1,884 |
| 1988 | 0 | 16 | 0 | 81 | 97 | 487 | 32 | 0 | 308 | 0 | 1,022 |
| 1989 | 875 | 147 | 97 | 369 | 38 | 228 | 46 | 4 | 47 | 0 | 1,852 |
| 1990 | 103 | 401 | 44 | 173 | 87 | 271 | 54 | 0 | 141 | 0 | 1,274 |
| 1991 | 582 | 293 | 0 | 478 | 139 | 31 | 31 | 0 | 31 | 0 | 1,585 |
| 1992 | 111 | 168 | 17 | 505 | 48 | 961 | 72 | 0 | 48 | 0 | 1,930 |
| 1993 | 1,702 | 326 | 936 | 351 | 50 | 451 | 100 | 50 | 100 | 0 | 4,067 |
| 1994 | 1,426 | 922 | 158 | 668 | 369 | 484 | 92 | 0 | 127 | 0 | 4,246 |
| 1995 | 2,539 | 388 | 292 | 3,536 | 151 | 485 | 280 | 11 | 43 | 0 | 7,725 |
| 1996 | 730 | 362 | 76 | 1,080 | 43 | 576 | 128 | 7 | 99 | 0 | 3,101 |
| 1997 | 1,114 | 450 | 148 | 1,059 | 42 | 616 | 83 | 7 | 55 | 0 | 3,574 |
| 1998 | 2,586 | 460 | 134 | 905 | 23 | 143 | 15 | 0 | 23 | 0 | 4,289 |
| 1999 | 215 | 248 | 108 | 1,123 | 0 | 256 | 23 | 0 | 0 | 0 | 1,973 |
| 2000 | 135 | 60 | 67 | 1,464 | 26 | 189 | 138 | 0 | 9 | 0 | 2,088 |
| 2001 | 145 | 160 | 18 | 152 | 16 | 409 | 8 | 8 | 0 | 0 | 916 |
| 2002 | 233 | 911 | 49 | 413 | 28 | 57 | 14 | 0 | 0 | 0 | 1,706 |
| 2003 | 155 | 157 | 71 | 1,904 | 84 | 94 | 167 | 0 | 10 | 0 | 2,642 |

[a] Age-.1 fish (age classes 0.1 and 1.1) were excluded from the spawner-recruit analysis. Age-.1 fish are not sampled in proportion to abundance at the Situk Weir and samples in Appendix D3 were stratified and applied separately to age-.1 and age-2.-.5 fish.

**Appendix D8.–**Estimated total run by calendar year and age class $\hat{T}_{at}$ of Situk River Chinook salmon, 1982-2003. [a]

| Year | 0.1 | 0.2 | 1.1 | 0.3 | 1.2 | 0.4 | 1.3 | 0.5 | 1.4 | 1.5 | Age-.3-.5 | Age-.2-.5 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 0 | 156 | 0 | 346 | 92 | 138 | 61 | 0 | 144 | 12 | 701 | 949 | 949 |
| 1983 | 10 | 268 | 0 | 524 | 180 | 151 | 162 | 0 | 6 | 0 | 842 | 1,290 | 1,300 |
| 1984 | 194 | 137 | 35 | 897 | 221 | 548 | 741 | 17 | 163 | 0 | 2,367 | 2,725 | 2,953 |
| 1985 | 195 | 318 | 22 | 693 | 375 | 433 | 462 | 29 | 577 | 29 | 2,223 | 2,916 | 3,133 |
| 1986 | 33 | 324 | 4 | 556 | 417 | 417 | 602 | 0 | 556 | 0 | 2,132 | 2,873 | 2,910 |
| 1987 | 287 | 79 | 32 | 1,142 | 39 | 315 | 984 | 0 | 315 | 0 | 2,756 | 2,874 | 3,193 |
| 1988 | 0 | 35 | 0 | 118 | 172 | 747 | 88 | 0 | 439 | 0 | 1,392 | 1,599 | 1,599 |
| 1989 | 875 | 225 | 97 | 544 | 74 | 338 | 103 | 4 | 89 | 0 | 1,078 | 1,377 | 2,349 |
| 1990 | 151 | 540 | 65 | 216 | 177 | 400 | 88 | 0 | 222 | 0 | 926 | 1,643 | 1,858 |
| 1991 | 593 | 491 | 3 | 1,039 | 228 | 123 | 136 | 7 | 61 | 3 | 1,370 | 2,089 | 2,685 |
| 1992 | 119 | 544 | 36 | 841 | 147 | 1,753 | 211 | 0 | 305 | 0 | 3,110 | 3,801 | 3,956 |
| 1993 | 1,776 | 497 | 996 | 650 | 171 | 690 | 214 | 64 | 250 | 4 | 1,871 | 2,539 | 5,311 |
| 1994 | 1,576 | 2,103 | 188 | 1,525 | 841 | 1,104 | 210 | 0 | 289 | 0 | 3,128 | 6,072 | 7,836 |
| 1995 | 2,789 | 934 | 342 | 10,680 | 424 | 1,304 | 1,545 | 11 | 68 | 0 | 13,608 | 14,966 | 18,096 |
| 1996 | 1,892 | 1,071 | 207 | 3,139 | 329 | 2,375 | 714 | 34 | 427 | 0 | 6,690 | 8,090 | 10,189 |
| 1997 | 1,693 | 1,346 | 232 | 2,929 | 85 | 1,878 | 198 | 37 | 87 | 9 | 5,138 | 6,568 | 8,493 |
| 1998 | 3,185 | 1,674 | 275 | 2,633 | 111 | 822 | 71 | 0 | 29 | 0 | 3,555 | 5,340 | 8,800 |
| 1999 | 610 | 1,496 | 147 | 4,457 | 113 | 872 | 162 | 10 | 50 | 0 | 5,550 | 7,159 | 7,916 |
| 2000 | 501 | 284 | 79 | 3,584 | 120 | 557 | 345 | 0 | 50 | 0 | 4,537 | 4,941 | 5,521 |
| 2001 | 412 | 406 | 53 | 524 | 46 | 1,107 | 194 | 17 | 52 | 0 | 1,892 | 2,345 | 2,810 |
| 2002 | 262 | 1,557 | 72 | 741 | 463 | 106 | 101 | 0 | 26 | 0 | 975 | 2,995 | 3,329 |
| 2003 | 261 | 450 | 79 | 4,912 | 212 | 318 | 360 | 0 | 42 | 0 | 5,632 | 6,294 | 6,634 |

[a] Age-.1 fish (age classes 0.1 and 1.1) were excluded from the spawner-recruit analysis.

**Appendix D9.–**Estimated standard errors by age class in total runs of Situk River Cinook salmon, 1982-2003.

| Year | 0.1 | 0.2 | 1.1 | 0.3 | 1.2 | 0.4 | 1.3 | 0.5 | 1.4 | 1.5 | Age-3.5 | Age-2.5 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 0 | 40 | 0 | 51 | 32 | 38 | 24 | 0 | 39 | 11 | 6 | 16 | 16 |
| 1983 | 5 | 35 | 0 | 43 | 30 | 28 | 29 | 0 | 6 | 0 | 8 | 11 | 15 |
| 1984 | 55 | 46 | 24 | 98 | 58 | 85 | 90 | 17 | 47 | 0 | 17 | 37 | 37 |
| 1985 | 99 | 66 | 17 | 91 | 71 | 76 | 78 | 21 | 85 | 21 | 36 | 74 | 131 |
| 1986 | 33 | 105 | 4 | 131 | 117 | 117 | 135 | 0 | 131 | 0 | 0 | 0 | 37 |
| 1987 | 145 | 40 | 25 | 121 | 29 | 77 | 117 | 0 | 77 | 0 | 12 | 19 | 161 |
| 1988 | 0 | 21 | 0 | 40 | 46 | 76 | 33 | 0 | 68 | 0 | 38 | 61 | 61 |
| 1989 | 67 | 54 | 67 | 71 | 32 | 63 | 36 | 9 | 35 | 0 | 0 | 0 | 0 |
| 1990 | 51 | 58 | 30 | 42 | 35 | 52 | 27 | 0 | 41 | 0 | 0 | 0 | 66 |
| 1991 | 9 | 62 | 3 | 73 | 46 | 27 | 28 | 4 | 24 | 3 | 36 | 51 | 56 |
| 1992 | 14 | 94 | 22 | 117 | 52 | 141 | 62 | 0 | 70 | 0 | 55 | 62 | 72 |
| 1993 | 169 | 83 | 164 | 87 | 40 | 93 | 52 | 36 | 53 | 3 | 45 | 55 | 99 |
| 1994 | 135 | 155 | 111 | 140 | 111 | 124 | 59 | 0 | 68 | 0 | 67 | 83 | 121 |
| 1995 | 122 | 122 | 91 | 331 | 84 | 144 | 163 | 11 | 31 | 0 | 295 | 333 | 353 |
| 1996 | 379 | 103 | 62 | 177 | 59 | 156 | 86 | 19 | 66 | 0 | 215 | 290 | 593 |
| 1997 | 192 | 106 | 58 | 172 | 25 | 116 | 37 | 17 | 24 | 9 | 257 | 351 | 505 |
| 1998 | 232 | 124 | 103 | 192 | 29 | 78 | 22 | 0 | 15 | 0 | 239 | 313 | 442 |
| 1999 | 157 | 113 | 52 | 228 | 33 | 89 | 38 | 10 | 20 | 0 | 242 | 291 | 345 |
| 2000 | 141 | 42 | 51 | 184 | 26 | 60 | 52 | 0 | 17 | 0 | 203 | 238 | 297 |
| 2001 | 111 | 44 | 22 | 48 | 16 | 63 | 28 | 10 | 15 | 0 | 37 | 25 | 144 |
| 2002 | 25 | 80 | 25 | 72 | 40 | 31 | 23 | 0 | 10 | 0 | 22 | 28 | 48 |
| 2003 | 39 | 57 | 29 | 111 | 41 | 49 | 53 | 0 | 17 | 0 | 81 | 118 | 168 |

**Appendix D10.–** Estimated percent by age class $\hat{p}_{at}$ in total runs of Situk River Chinook salmon, 1982-2003, for fish age-2. and older.

| Year | 0.2 | 0.3 | 1.2 | 0.4 | 1.3 | 0.5 | 1.4 | 1.5 |
|---|---|---|---|---|---|---|---|---|
| 1982 | 16.5% | 36.5% | 9.7% | 14.5% | 6.5% | 0.0% | 15.2% | 1.3% |
| 1983 | 20.8% | 40.6% | 13.9% | 11.7% | 12.6% | 0.0% | 0.4% | 0.0% |
| 1984 | 5.0% | 32.9% | 8.1% | 20.1% | 27.2% | 0.6% | 6.0% | 0.0% |
| 1985 | 10.9% | 23.8% | 12.9% | 14.9% | 15.8% | 1.0% | 19.8% | 1.0% |
| 1986 | 11.3% | 19.4% | 14.5% | 14.5% | 21.0% | 0.0% | 19.4% | 0.0% |
| 1987 | 2.7% | 39.7% | 1.4% | 11.0% | 34.2% | 0.0% | 11.0% | 0.0% |
| 1988 | 2.2% | 7.4% | 10.7% | 46.7% | 5.5% | 0.0% | 27.4% | 0.0% |
| 1989 | 16.3% | 39.5% | 5.4% | 24.5% | 7.5% | 0.3% | 6.5% | 0.0% |
| 1990 | 32.8% | 13.2% | 10.8% | 24.3% | 5.3% | 0.0% | 13.5% | 0.0% |
| 1991 | 23.5% | 49.8% | 10.9% | 5.9% | 6.5% | 0.3% | 2.9% | 0.2% |
| 1992 | 14.3% | 22.1% | 3.9% | 46.1% | 5.5% | 0.0% | 8.0% | 0.0% |
| 1993 | 19.6% | 25.6% | 6.7% | 27.2% | 8.4% | 2.5% | 9.8% | 0.1% |
| 1994 | 34.6% | 25.1% | 13.9% | 18.2% | 3.5% | 0.0% | 4.8% | 0.0% |
| 1995 | 6.2% | 71.4% | 2.8% | 8.7% | 10.3% | 0.1% | 0.5% | 0.0% |
| 1996 | 13.2% | 38.8% | 4.1% | 29.4% | 8.8% | 0.4% | 5.3% | 0.0% |
| 1997 | 20.5% | 44.6% | 1.3% | 28.6% | 3.0% | 0.6% | 1.3% | 0.1% |
| 1998 | 31.4% | 49.3% | 2.1% | 15.4% | 1.3% | 0.0% | 0.5% | 0.0% |
| 1999 | 20.9% | 62.3% | 1.6% | 12.2% | 2.3% | 0.1% | 0.7% | 0.0% |
| 2000 | 5.7% | 72.5% | 2.4% | 11.3% | 7.0% | 0.0% | 1.0% | 0.0% |
| 2001 | 17.3% | 22.4% | 2.0% | 47.2% | 8.3% | 0.7% | 2.2% | 0.0% |
| 2002 | 52.0% | 24.7% | 15.5% | 3.5% | 3.4% | 0.0% | 0.9% | 0.0% |
| 2003 | 7.2% | 78.0% | 3.4% | 5.1% | 5.7% | 0.0% | 0.7% | 0.0% |

**Appendix D11.–**Estimated percent by age class $\hat{p}_{at}$ in total runs of Situk River Chinook salmon, 1989-2003, for fish age-1. and older. [a]

| Year | 0.1 | 0.2 | 1.1 | 0.3 | 1.2 | 0.4 | 1.3 | 0.5 | 1.4 | 1.5 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1989 | 37.2% | 9.6% | 4.1% | 23.2% | 3.2% | 14.4% | 4.4% | 0.2% | 3.8% | 0.0% |
| 1990 | 8.1% | 29.0% | 3.5% | 11.6% | 9.6% | 21.5% | 4.7% | 0.0% | 12.0% | 0.0% |
| 1991 | 22.1% | 18.3% | 0.1% | 38.7% | 8.5% | 4.6% | 5.1% | 0.2% | 2.3% | 0.1% |
| 1992 | 3.0% | 13.8% | 0.9% | 21.3% | 3.7% | 44.3% | 5.3% | 0.0% | 7.7% | 0.0% |
| 1993 | 33.4% | 9.4% | 18.7% | 12.2% | 3.2% | 13.0% | 4.0% | 1.2% | 4.7% | 0.1% |
| 1994 | 20.1% | 26.8% | 2.4% | 19.5% | 10.7% | 14.1% | 2.7% | 0.0% | 3.7% | 0.0% |
| 1995 | 15.4% | 5.2% | 1.9% | 59.0% | 2.3% | 7.2% | 8.5% | 0.1% | 0.4% | 0.0% |
| 1996 | 18.6% | 10.5% | 2.0% | 30.8% | 3.2% | 23.3% | 7.0% | 0.3% | 4.2% | 0.0% |
| 1997 | 19.9% | 15.8% | 2.7% | 34.5% | 1.0% | 22.1% | 2.3% | 0.4% | 1.0% | 0.1% |
| 1998 | 36.2% | 19.0% | 3.1% | 29.9% | 1.3% | 9.3% | 0.8% | 0.0% | 0.3% | 0.0% |
| 1999 | 7.7% | 18.9% | 1.9% | 56.3% | 1.4% | 11.0% | 2.0% | 0.1% | 0.6% | 0.0% |
| 2000 | 9.1% | 5.1% | 1.4% | 64.9% | 2.2% | 10.1% | 6.3% | 0.0% | 0.9% | 0.0% |
| 2001 | 14.7% | 14.4% | 1.9% | 18.6% | 1.6% | 39.4% | 6.9% | 0.6% | 1.8% | 0.0% |
| 2002 | 7.9% | 46.8% | 2.2% | 22.3% | 13.9% | 3.2% | 3.0% | 0.0% | 0.8% | 0.0% |
| 2003 | 3.9% | 6.8% | 1.2% | 74.0% | 3.2% | 4.8% | 5.4% | 0.0% | 0.6% | 0.0% |

[a] Age-.1 fish (age classes 0.1 and 1.1) were not enumerated at the Situk River weir prior to 1989. Age-.1 fish were not fully enumerated in other years (1999-present) due to changes in weir design.

**Appendix D12.-**Annual exploitation rates $\hat{U}_t$ for Chinook salmon.

Annual exploitation rates $U_t$ for Chinook salmon were estimated as follows:

$$\hat{U}_t = \frac{\hat{H}_t}{\hat{H}_t + \hat{S}_t}$$

where

$\hat{H}_t$ is the estimated harvest of Chinook salmon of age-.2-.5 fish in year *t*,

and

$\hat{S}_t$ is the estimated spawning abundance of Chinook salmon of age-.2-.5 fish in year *t*.

Calculation of $\hat{S}_t$ is described in Appendix C. Calculation of $\hat{H}_t$ is the sum of the tallied harvests of age-.2-.5 Chinook salmon in all gillnet and recreational fisheries (see tables above for statistics).

Variance for estimated exploitation rates can be approximated with the delta method (Seber 1982:7-9):

$$v(\hat{U}_t) \cong$$

$$v(\hat{H}_t)\frac{\hat{S}_t^2}{\left(\hat{H}_t + \hat{S}_t\right)^4}$$

$$+ v(\hat{S}_t)\frac{\hat{H}_t^2}{\left(\hat{H}_t + \hat{S}_t\right)^4}$$

Since harvest is estimated only for the recreational fishery and "known" for other fisheries (at least for our purposes), estimated variance $v(\hat{H}_t)$ is the estimated variance for the recreational fishery.

# APPENDIX E:
# ADJUSTMENT IN $\hat{\ln\alpha}$ FOR SERIAL CORRELATION

**Appendix E1.–**Adjustment in $\hat{\ln\alpha}$ for Serial Correlation.

(per David Bernard, ADF&G, Sport Fish Division, Anchorage, 1/30/03)

From Noakes et al. 1987, the stock-recruit relationship under an autoregressive process of lag one brood year is:

$$\ln(R_t/S_t) = (1-\phi)\ln\alpha + \phi\ln(R_{t-1}/S_{t-1}) - \beta S_t + \phi\beta S_{t-1} + u_t \qquad \text{E.1}$$

with R representing production, S escapement that produces that production, $\alpha$ the density-independent parameter, $\beta$ the density-dependent parameter, $\phi$ the autoregressive parameter, u a normally distributed stochastic variate with mean 0 and variance $\sigma^2$, and t the year. The equation above can be rewritten as:

$$\ln R_t = \ln\alpha + \ln S_t - \beta S_t + \phi\{\ln(R_{t-1}/S_{t-1}) - \ln\alpha + \phi\beta S_{t-1}\} + u_t \qquad \text{E.2}$$

with the term in brackets representing the residual (process error) $\varepsilon$ from year t – 1. Exponentiating both sides of the equation above gives:

$$R_t = \exp(\ln\alpha) S_t \exp(-\beta S_t)\exp(\phi\varepsilon_{t-1})\exp(u_t) \qquad \text{E.3}$$

with the residual (bracketed term in eq. E.2) defined now as $\varepsilon_{t-1}$. Taking expectations of both sides (to get the average R given a specific S) produces:

$$E[R_t] = \exp(\ln\alpha) S_t \exp(-\beta S_t) E[\exp(\phi\varepsilon_{t-1})\exp(u_t)] \qquad \text{E.4}$$

The residual $\varepsilon_{t-1}$ is a function of $u_{t-1}$, and $u_{t-1}$ is independent of $u_t$,. For this reason:

$$E[\exp(\phi\varepsilon_{t-1})\exp(u_t)] = E[\exp(\phi\varepsilon_{t-1})]E[\exp(u_t)] \qquad \text{E.5}$$

From the moment-generating function for a normally distributed variate x with variance $\sigma^2$:

$$E[\exp(cx)] = \exp\left(\frac{c^2\sigma^2}{2}\right) \qquad \text{E.6+}$$

In the context of eq. E.5, eq. E.6 means:

$$E[\exp(u_t)] = \exp(\sigma^2/2) \qquad \text{E.7}$$

$$E[\exp(\phi\varepsilon_{t-1})] = \exp\left(\frac{\phi^2 V(\varepsilon_{t-1})}{2}\right) \qquad \text{E.8}$$

where $V(\varepsilon_{t-1})$ is the variance of $\varepsilon_{t-1}$. An expectation requires not a specific residual at t –1, but an integration over all possible residuals to estimate the most likely value of this "unknown" residual. Under this circumstance:

$$V(\varepsilon_{t-1}) = \frac{\sigma^2}{(1-\phi^2)} \qquad \text{E.9}$$

(from Abraham and Ledolter 1983, bottom of p. 278 in their estimation of variance for the residual immediately prior to the beginning of a time series). Substitution of eq. E.9 into E.8 with the result plugged into eq. E.4 along with eq. E.6 produces:

$$E[R_t] = \exp(\ln\alpha)S_t \exp(-\beta S_t)\exp\left(\frac{\phi^2\sigma^2}{2(1-\phi^2)} + \frac{\sigma^2}{2}\right) \qquad \text{E.10}$$

Simplifying and repackaging produces:

$$E[R_t] = \left\{\exp\left(\ln\alpha + \frac{\sigma^2}{2(1-\phi^2)}\right)\right\}S_t \exp(-\beta S_t) \qquad \text{E.11}$$

From this relationship note that:

$$\alpha = \exp\left(\ln\alpha + \frac{\sigma^2}{2(1-\phi^2)}\right) \qquad \text{E.12}$$

At this point, unbiased estimates of the parameters can be used to produce:

$$\ln\hat{\alpha} = \hat{\ln\alpha} + \frac{\hat{\sigma}^2}{2(1-\hat{\phi}^2)} \qquad \text{E.13}$$

with $\hat{\sigma}^2$ being the mean square error from fitting eq. E.1 to data. Note that without serial correlation ($\phi$ = 0), eq. E.13 is the same as that given in Hilborn 1985.

# APPENDIX F:
# LEVERAGE, COOK'S DISTANCE AND OUTLIERS

**Appendix F1.–**Outliers, leverage, and Cook's distance.

It is clear that a single outlier in a set of data, if located sufficiently far away, can completely change the outcome of a least squares analysis. Outliers are data points that split off or are very different from the remainder of the data. To obtain some objective criteria for inclusion or removal of any data points in the spawner-recruit database for Situk River Chinook salmon, we calculated leverage and Cook's distance (Cook and Weisberg 1982) for each year class, when all (1977-1998) were included in the regression for the Ricker lognormal model (Ricker 1975). These both were calculated using SAS (PROC GLM). The leverage measures how far a single independent variable value (in this case spawners in a particular year) is from the average of all the independent variable values. An influential point is one that has a large effect on the slope of the log-linear model that is fit to the data. Cook's distance is one measure that can be used to determine which, if any, data points are influential points or outliers. Cook and Weisberg (1982) indicate that a Cook's distance of greater than one is generally considered to be large.

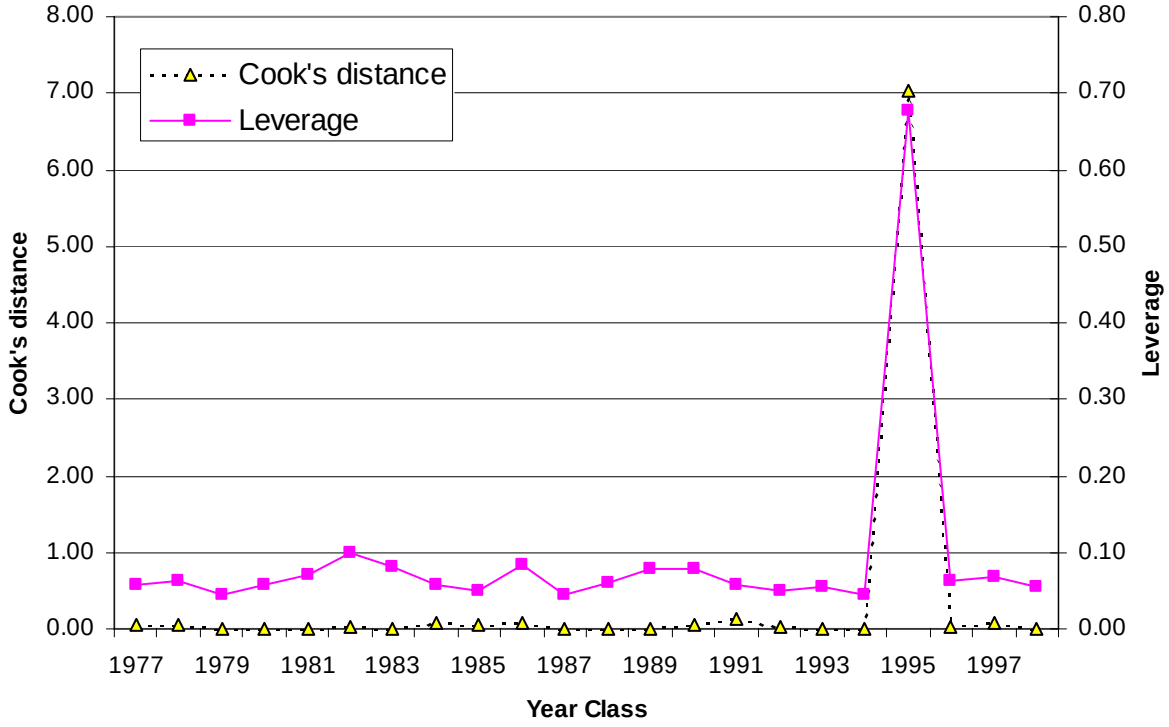
Leverage was ≤0.10 for all year classes except 1995, for which leverage was 0.68 (Appendices F1 and F3). It is unclear what threshold value of leverage is considered significant, but 0.68 is in the category of highly significant and about 7 times the next highest value of 0.10 for the 1982 year class. Cook's Distance values were ≤0.14 for all year classes except 1995, for which it was 7.03, or 50 times the value of 0.14 for the 1991 year class, the next highest value. It is clear that the 1995 year class was both far from average and had a significant effect on the outcome of the regression. In contrast, the year class with the highest production (1991) had about a median value for leverage (0.06) and a Cook's distance value (0.14) well below 1. However, it is clear, from a simple graphical presentation of the observed and predicted ln(R/S) values, that other observed data points were nearly as distance from predicted, except 1995 (Appendix F2).

The 1995 year class accordingly exerted considerable influence on the spawner-recruit relationship. We used a leaving-one-out technique to determine the extent of influence by the 1995 and all other year classes, on spawner-recruit parameters using a multiplicative log-normal Ricker model (Ricker 1975). We made no attempt to adjust parameters for each run for the autocorrelation done for parameters presented in the main body of this manuscript and described in Appendix E. These results are presented simply to illustrate the effect of all brood years on the spawner-recruit relationship for the Chinook salmon stock from the Situk River.

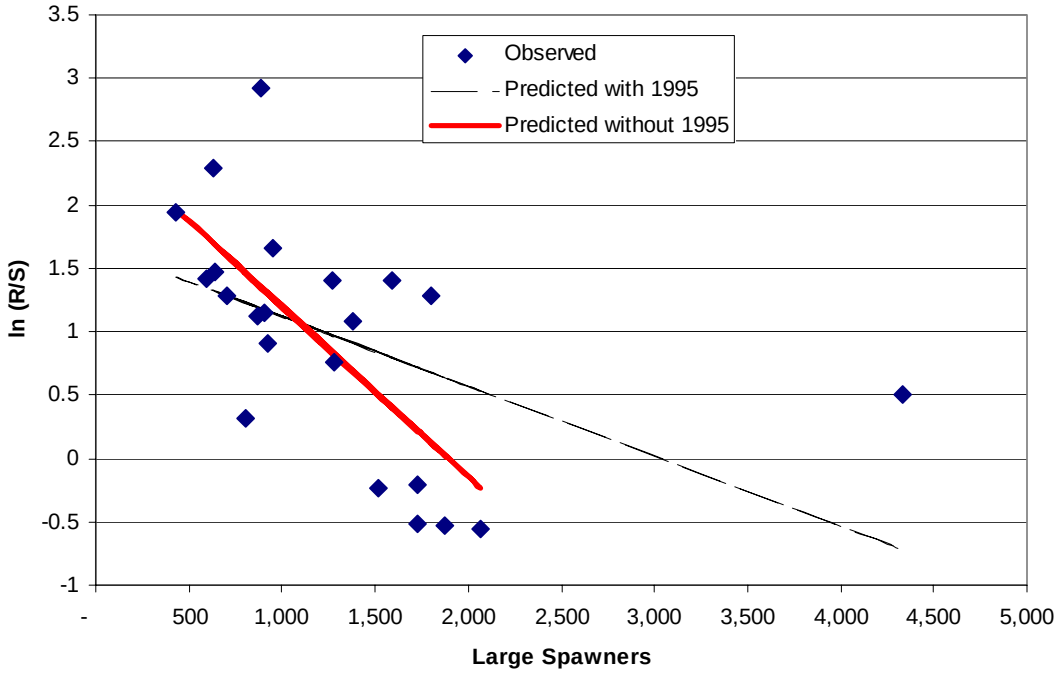
In the first series of leaving-one-out runs, we used all year classes (1977-1998) and found that exclusion of a single year class had no meaningful effect on the spawner-recruit parameters, with the exception of 1995 (Appendix F4). In all runs with 1995 included, $S_{MSY}$ averaged 1,255, about double $S_{MSY}$ when 1995 was excluded. The parameter α was about half and β and replacement were about double in all runs with 1995, versus the single run excluding 1995. MSY was predicted to be 11% higher (2,940 vs. 2,627) and $U_{MSY}$—the estimated exploitation rate at MSY—22% higher (83% vs. 68%), when 1995 was excluded, versus the average for all other runs.

In the second series of leaving-one-out runs, we first excluded 1995, then left each of the remaining 20 year classes out of one of the following 21 runs (Appendix F5). All parameter estimates exhibited stability, with CVs ranging from 2.8% to 8.6%. $S_{MSY}$ averaged 614 with a CV of 3.8%, replacement averaged 1,918 with a CV of 2.8%, and MSY averaged 2,947 with a CV of 6.2%. The fit was significantly improved, with $R^2$ averaging 0.46 vs. an average of 0.20 in the runs in Appendix F2 with 1995 included.

**Appendix F2.–**Estimated Cook's distance and leverage from regression of the spawner-recruit relationship for Chinook salmon from the Situk River for year classes 1977-1998, using a multiplicative log-normal Ricker model.




**Appendix F3.–**Observed ln(R/S) and predicted values, both with and without the 1995 year class, for Situk River Chinook salmon, 1977-1998 year classes.



**Appendix F4.–**Estimated escapement, recruits, leverage and Cook's distance for the 1977-1998 year classes of Situk River Chinook salmon.

| Year class | Spawners | Recruits | LN(R/S) | Predicted | Residual | Leverage | Cook's Distance |
|---|---|---|---|---|---|---|---|
| 1977 | 1,732 | 1,405 | -0.2093 | 0.7192 | -0.9285 | 0.06 | 0.04 |
| 1978 | 808 | 1,110 | 0.3173 | 1.2291 | -0.9117 | 0.06 | 0.04 |
| 1979 | 1,284 | 2,755 | 0.7636 | 0.9664 | -0.2028 | 0.05 | 0.00 |
| 1980 | 905 | 2,838 | 1.1428 | 1.1755 | -0.0328 | 0.06 | 0.00 |
| 1981 | 702 | 2,539 | 1.2857 | 1.2875 | -0.0019 | 0.07 | 0.00 |
| 1982 | 434 | 3,028 | 1.9428 | 1.4354 | 0.5073 | 0.10 | 0.02 |
| 1983 | 592 | 2,434 | 1.4138 | 1.3482 | 0.0656 | 0.08 | 0.00 |
| 1984 | 1,726 | 1,035 | -0.5117 | 0.7225 | -1.2341 | 0.06 | 0.07 |
| 1985 | 1,521 | 1,208 | -0.2304 | 0.8356 | -1.0660 | 0.05 | 0.04 |
| 1986 | 2,067 | 1,187 | -0.5544 | 0.5343 | -1.0887 | 0.08 | 0.09 |
| 1987 | 1,379 | 4,084 | 1.0858 | 0.9140 | 0.1719 | 0.05 | 0.00 |
| 1988 | 868 | 2,672 | 1.1245 | 1.1959 | -0.0715 | 0.06 | 0.00 |
| 1989 | 637 | 2,758 | 1.4656 | 1.3234 | 0.1422 | 0.08 | 0.00 |
| 1990 | 628 | 6,182 | 2.2869 | 1.3284 | 0.9585 | 0.08 | 0.06 |
| 1991 | 889 | 16,420 | 2.9162 | 1.1844 | 1.7318 | 0.06 | 0.14 |
| 1992 | 1,595 | 6,506 | 1.4059 | 0.7948 | 0.6111 | 0.05 | 0.02 |
| 1993 | 952 | 5,038 | 1.6662 | 1.1496 | 0.5166 | 0.05 | 0.01 |
| 1994 | 1,271 | 5,173 | 1.4037 | 0.9736 | 0.4301 | 0.05 | 0.01 |
| **1995** | **4,330** | **7,214** | **0.5105** | **-0.7145** | **1.2249** | **0.68** | **7.03** |
| 1996 | 1,800 | 6,527 | 1.2882 | 0.6816 | 0.6065 | 0.06 | 0.02 |
| 1997 | 1,878 | 1,103 | -0.5322 | 0.6386 | -1.1708 | 0.07 | 0.08 |
| 1998 | 924 | 2,289 | 0.9072 | 1.1650 | -0.2579 | 0.06 | 0.00 |
| Average | 1,315 | 3,887 | | | 0.0000 | 0.09 | 0.35 |

**Appendix F5.–**Estimated spawner-recruit parameters for Situk River Chinook salmon for year classes 1977-1998, excluding each year class in succeeding runs.

| BY left out | $-\beta$ | $\alpha$ | $S_{MSY}$ | $R^2$ | $R_r$ | $S_r$ | $R_{MSY}$ | MSY | $U_{MSY}$ |
|---|---|---|---|---|---|---|---|---|---|
| none | -0.00055182 | 6.1277 | 1,230 | 0.20 | 3,285 | 3,285 | 3,823 | 2,593 | 68% |
| 1977 | -0.00052322 | 6.1367 | 1,297 | 0.19 | 3,468 | 3,468 | 4,038 | 2,741 | 68% |
| 1978 | -0.00058612 | 6.6669 | 1,192 | 0.23 | 3,237 | 3,237 | 3,951 | 2,760 | 70% |
| 1979 | -0.00055227 | 6.2984 | 1,240 | 0.20 | 3,332 | 3,332 | 3,938 | 2,698 | 69% |
| 1980 | -0.00055281 | 6.2590 | 1,236 | 0.20 | 3,318 | 3,318 | 3,907 | 2,670 | 68% |
| 1981 | -0.00055190 | 6.2425 | 1,237 | 0.19 | 3,318 | 3,318 | 3,902 | 2,665 | 68% |
| 1982 | -0.00051731 | 5.7701 | 1,283 | 0.17 | 3,388 | 3,388 | 3,812 | 2,529 | 66% |
| 1983 | -0.00054823 | 6.1909 | 1,242 | 0.19 | 3,325 | 3,325 | 3,892 | 2,650 | 68% |
| 1984 | -0.00051436 | 6.0431 | 1,312 | 0.19 | 3,497 | 3,497 | 4,038 | 2,726 | 68% |
| 1985 | -0.00053574 | 6.2310 | 1,273 | 0.20 | 3,415 | 3,415 | 4,011 | 2,737 | 68% |
| 1986 | -0.00048956 | 5.8669 | 1,364 | 0.17 | 3,614 | 3,614 | 4,104 | 2,740 | 67% |
| 1987 | -0.00055263 | 6.1919 | 1,232 | 0.20 | 3,299 | 3,299 | 3,862 | 2,629 | 68% |
| 1988 | -0.00055418 | 6.2814 | 1,235 | 0.20 | 3,316 | 3,316 | 3,913 | 2,678 | 68% |
| 1989 | -0.00054456 | 6.1352 | 1,246 | 0.19 | 3,331 | 3,331 | 3,879 | 2,633 | 68% |
| 1990 | -0.00050215 | 5.4324 | 1,291 | 0.17 | 3,370 | 3,370 | 3,667 | 2,377 | 65% |
| 1991 | -0.00049739 | 4.9148 | 1,249 | 0.21 | 3,201 | 3,201 | 3,298 | 2,049 | 62% |
| 1992 | -0.00056438 | 6.0986 | 1,200 | 0.21 | 3,204 | 3,204 | 3,718 | 2,518 | 68% |
| 1993 | -0.00053804 | 5.9345 | 1,246 | 0.19 | 3,310 | 3,310 | 3,783 | 2,536 | 67% |
| 1994 | -0.00055045 | 6.0726 | 1,228 | 0.20 | 3,277 | 3,277 | 3,794 | 2,565 | 68% |
| **1995** | **-0.00134955** | **13.2558** | **613** | **0.46** | **1,915** | **1,915** | **3,553** | **2,940** | **83%** |
| 1996 | -0.00057365 | 6.1729 | 1,186 | 0.22 | 3,173 | 3,173 | 3,707 | 2,522 | 68% |
| 1997 | -0.00050262 | 5.9589 | 1,336 | 0.18 | 3,551 | 3,551 | 4,068 | 2,732 | 67% |
| 1998 | -0.00055924 | 6.3694 | 1,230 | 0.20 | 3,311 | 3,311 | 3,938 | 2,708 | 69% |

The number of year classes is 22 in the first row and 21 in each succeeding row.

**Appendix F6.–**Estimated spawner-recruit parameters for Situk River Chinook salmon for year classes 1977-1998, excluding 1995 from all runs and then excluding one of each of the remaining year classes in succeeding runs.

| BY left out | $-\beta$ | $\alpha$ | $S_{MSY}$ | $R^2$ | $R_r$ | $S_r$ | $R_{MSY}$ | MSY | $U_{MSY}$ |
|---|---|---|---|---|---|---|---|---|---|
| 1995 | -0.00134955 | 13.2558 | 613 | 0.46 | 1,915 | 1,915 | 3,553 | 2,940 | 83% |
| 1977 | -0.00129448 | 12.8148 | 635 | 0.42 | 1,970 | 1,970 | 3,577 | 2,942 | 82% |
| 1978 | -0.00144202 | 15.2701 | 588 | 0.53 | 1,890 | 1,890 | 3,845 | 3,258 | 85% |
| 1979 | -0.00134822 | 13.4515 | 615 | 0.46 | 1,928 | 1,928 | 3,611 | 2,995 | 83% |
| 1980 | -0.00136047 | 13.7253 | 612 | 0.46 | 1,925 | 1,925 | 3,653 | 3,041 | 83% |
| 1981 | -0.00138342 | 14.1719 | 605 | 0.46 | 1,916 | 1,916 | 3,713 | 3,108 | 84% |
| 1982 | -0.00135359 | 13.5175 | 613 | 0.43 | 1,924 | 1,924 | 3,615 | 3,001 | 83% |
| 1983 | -0.00139524 | 14.3843 | 601 | 0.46 | 1,911 | 1,911 | 3,738 | 3,137 | 84% |
| 1984 | -0.00125520 | 12.3049 | 650 | 0.42 | 2,000 | 2,000 | 3,537 | 2,887 | 82% |
| 1985 | -0.00129287 | 12.8475 | 636 | 0.45 | 1,975 | 1,975 | 3,591 | 2,955 | 82% |
| 1986 | -0.00127547 | 12.5139 | 642 | 0.38 | 1,981 | 1,981 | 3,542 | 2,900 | 82% |
| 1987 | -0.00136755 | 13.3896 | 606 | 0.47 | 1,897 | 1,897 | 3,543 | 2,937 | 83% |
| 1988 | -0.00136661 | 13.8607 | 610 | 0.46 | 1,924 | 1,924 | 3,674 | 3,063 | 83% |
| 1989 | -0.00137734 | 14.0271 | 607 | 0.45 | 1,917 | 1,917 | 3,690 | 3,083 | 84% |
| 1990 | -0.00127627 | 11.8273 | 635 | 0.42 | 1,936 | 1,936 | 3,339 | 2,705 | 81% |
| 1991 | -0.00125232 | 10.2966 | 628 | 0.50 | 1,862 | 1,862 | 2,945 | 2,317 | 79% |
| 1992 | -0.00144577 | 13.8385 | 577 | 0.52 | 1,817 | 1,817 | 3,467 | 2,890 | 83% |
| 1993 | -0.00133038 | 12.8150 | 618 | 0.45 | 1,917 | 1,917 | 3,481 | 2,862 | 82% |
| 1994 | -0.00136187 | 13.1252 | 607 | 0.47 | 1,890 | 1,890 | 3,485 | 2,879 | 83% |
| 1996 | -0.00152326 | 14.7940 | 553 | 0.55 | 1,769 | 1,769 | 3,524 | 2,971 | 84% |
| 1997 | -0.00125543 | 12.2890 | 650 | 0.40 | 1,998 | 1,998 | 3,532 | 2,882 | 82% |
| 1998 | -0.00137105 | 13.9940 | 609 | 0.47 | 1,925 | 1,925 | 3,698 | 3,089 | 84% |
| Average | -0.00134902 | 13.2961 | 614 | 0.46 | 1,918 | 1,918 | 3,561 | 2,947 | 82.7% |
| SD | 0.00006833 | 1.08 | 23 | 0.04 | 54 | 54 | 176 | 183 | 1.3% |
| CV | 5.1% | 8.1% | 3.8% | 8.6% | 2.8% | 2.8% | 4.9% | 6.2% | 1.6% |

The number of year classes is 21 in the first row and 20 in each succeeding row.