Fishery Data Series No. 97-33

Escapements of Chinook Salmon in Southeast Alaska and Transboundary Rivers in 1996

by

Keith A. Pahlke

November 1997

Alaska Department of Fish and Game

Division of Sport Fish

Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Spell out acre and ton.

Time and temperature

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

Spell out year, month, and week.

Physics and chemistry

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

General

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

Mathematics, statistics, fisheries

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

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ABSTRACT

As part of a continuing stock assessment program in Southeast Alaska, the Division of Sport Fish obtained indices of escapement for chinook salmon *Oncorhynchus tshawytscha* in designated streams and transboundary rivers. The estimated total escapement in 1996 was 128,686 large (age .3+) chinook, a 65% increase from the 78,226 fish estimated in 1995. The 1996 estimate was over three times the 1975–1980 base period average of 40,949 chinook salmon, twice the 1981–1985 average of 63,580 and 149% of the 1986–1990 average of 86,474. The estimated total exceeded the goal for the region for the second time in 3 years, primarily due to a record high escapement to the Taku River.

Escapement indices exceeded management goals in the Taku, Situk, Chilkat, Unuk and King Salmon Rivers and were near goals in the Stikine and Keta Rivers and Andrew Creek. The Alsek River escapement dropped below goal after exceeding it for the first time in 1995. Escapements to the Chickamin and Blossom Rivers improved slightly over 1995 but remained below goals.

Key words: Chinook, *Oncorhynchus tshawytscha*, escapement, Taku River, Stikine River, Alsek River, Chilkat River, Unuk River, Chickamin River, Blossom River, Keta River, Marten River, Wilson River, King Salmon River, Situk River, Andrew Creek, Behm Canal, Southeast Alaska, U.S./Canada Treaty, transboundary rivers.

INTRODUCTION

Chinook salmon *Oncorhynchus tshawytscha* are known to occur in 34 rivers in, or draining into, the Southeast region of Alaska from British Columbia or Yukon Territory, Canada (Figure 1). In the mid-1970s it became apparent that many of the chinook salmon stocks in this region were depressed relative to historical levels of production (Kissner 1974), and a fisheries management program was implemented to rebuild stocks in Southeast Alaska streams and in transboundary rivers (rivers that originate in Canada and flow into Southeast Alaska coastal waters; ADF&G 1981). Initially, this management program closed commercial and recreational fisheries in terminal and near-terminal areas in U.S. waters.

In 1981, this program was formalized and expanded to a 15-year (roughly 3 life-cycles) rebuilding program for the transboundary Taku, Stikine, Alsek, Unuk, Chickamin, and Chilkat rivers and the non-transboundary Blossom, Keta, Situk, and King Salmon rivers (ADF&G 1981). The program used regionwide, all-gear catch ceilings for chinook salmon, designed to rebuild spawning escapements by 1995 (ADF&G 1981). Then, in 1985, the Alaskan program was incorporated into a comprehensive coast-wide rebuilding program under the auspices of the U.S./Canada Pacific Salmon Treaty (PST) for all wild stocks of chinook salmon.

To track the rate of rebuilding, the Alaska Department of Fish and Game (ADF&G), the Canadian Department of Fisheries and Oceans (DFO), and the Taku River Tlingit First Nation (TRTFN) count spawning chinook salmon in a designated set of watersheds (Appendix A1). These streams were selected on the basis of their historical importance to fisheries, size of the population, geographic distribution, extent of the historical database, and ease of data collection. Counts from each of these streams are considered to be indicators of relative abundance, based on the assumption that counts are a relatively constant proportion of the annual escapement in an index area or watershed. These data are provided annually to the Joint Chinook Technical Committee (CTC) of the Pacific Salmon Commission (PSC), who use them to evaluate rebuilding progress of escapement indicator stocks (PSC 1996).

Judgments as to rebuilding progress provide a basis for regulations to restrict or expand fisheries to achieve rebuilding goals.

As part of a continuing program by the Division of Sport Fish to improve wild chinook

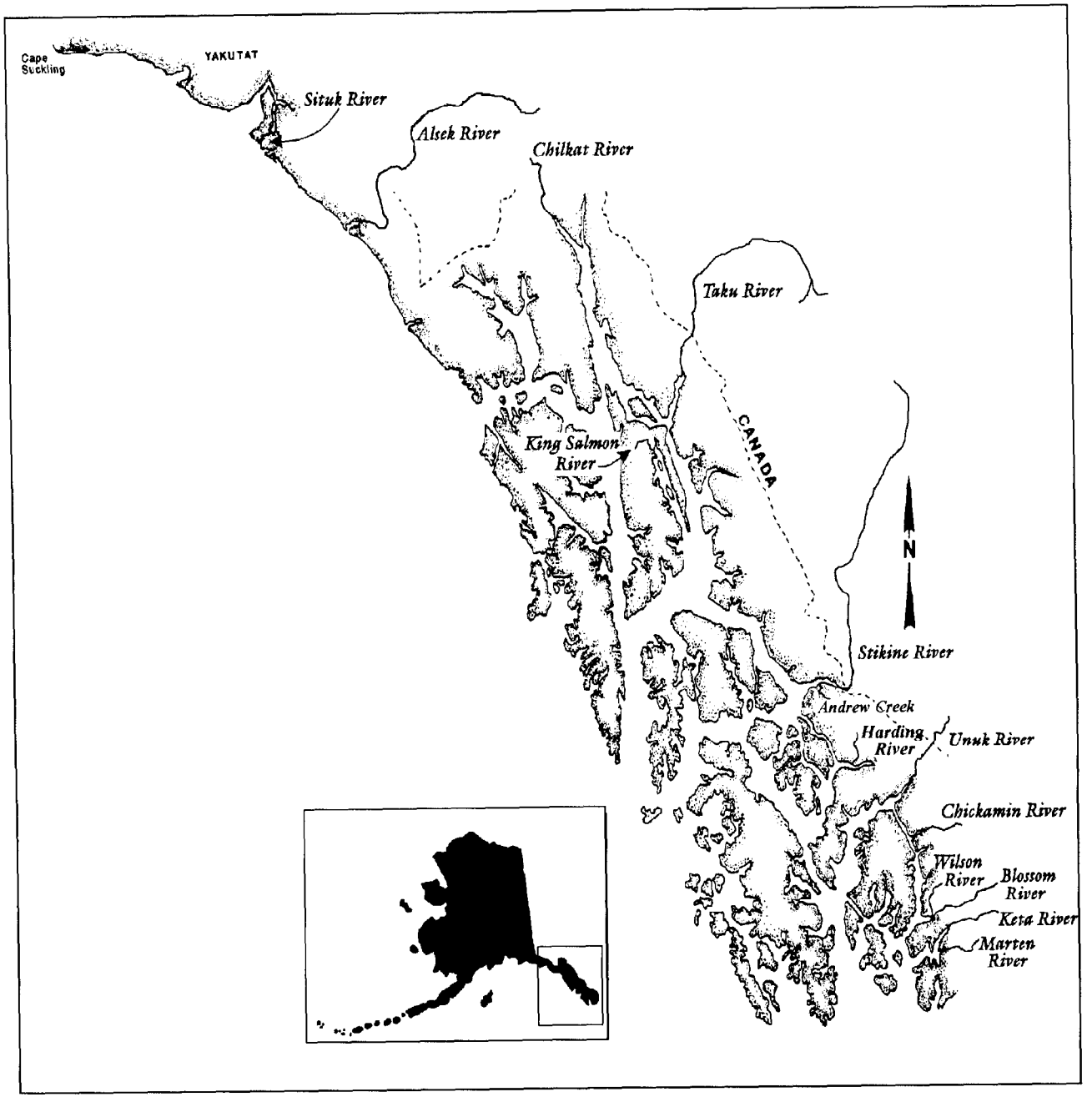

Figure 1.–Location of selected chinook salmon systems in Southeast Alaska.

stocks, this project obtained indices of spawner abundance for major chinook salmon stocks in Southeast Alaska. Objectives for 1996 were to count large (≥660 mm mid-eye to fork length, or ocean-age 3 and older) spawning chinook salmon during the time of peak abundance in tributaries and mainstem areas of the Stikine, Taku, Alsek, Situk, Unuk, Chickamin, Keta, Blossom, King Salmon rivers and in Andrew Creek and to compile and compare the indices to those from past years.

DESCRIPTION OF STUDY SITES

Many individual spawning areas are surveyed annually in a designated set of watersheds. Detailed descriptions and locations of these areas are found in Mecum and Kissner (1989), and general descriptions of the watersheds are below.

The Taku River originates in northern British Columbia and flows into the ocean 48 km east of Juneau, Alaska. The Taku River drainage covers over 17,000 km^2; average monthly flows range from 60 m^3/sec in February to 1,097 m^3/sec in June (Bigelow et al. 1995). Principal tributaries are the Sloko, Nakina, Sheslay, Inklin, and Nahlin rivers. The clearwater Nakina and Nahlin rivers contribute less than 25% of the total drainage discharge; most is from glacier-fed streams on the eastern slope of the Coast Range of British Columbia. Upstream of the abandoned mining community of Tulsequah, British Columbia, the drainage remains in pristine condition, with very few mining, logging, or other development activities. The upper Taku River area is extremely remote, with no road access and few year-round residents. All of the important chinook salmon spawning areas are in tributaries in the upper drainage in British Columbia.

Stock assessment of chinook salmon has been conducted intermittently on the Taku River since the 1950s, and helicopter surveys of the index areas have been conducted annually since 1973. Survey index areas include portions of the Nakina, Nahlin, Dudidontu, Tatsamenie, Hackett, and Kowatua rivers and Tseta Creek. In addition the DFO, TRTFN, and ADF&G have operated a carcass collection weir below the major spawning area on the Nakina river since 1973. The carcass weir provides an estimate of the age composition of the escapement. Ongoing mark-recapture experiments are providing independent estimates of total escapement (McPherson et al. 1996).

The Stikine River originates in British Columbia and flows to the sea approximately 32 km south of Petersburg, Alaska. Its drainage covers about 52,000 km^2, nearly 90% of which is inaccessible to anadromous fish because of natural barriers and velocity blocks. The Stikine River's principal tributaries include the Tahltan, Chutine, Scud, Iskut, and Tuya rivers. The lower river and most tributaries are glacially occluded (e.g., Chutine, Scud, and Iskut rivers).

Only 2% of the Stikine River drainage is in Alaska (Beak Consultants Limited 1981), and the majority of the chinook salmon spawning areas in the Stikine River are located in British Columbia, Canada, in the mainstem Tahltan and Little Tahltan rivers (including Beatty Creek). However, Andrew Creek, in the lower Stikine River, supports a significant run of chinook salmon. The upper drainage of the Stikine is accessible via the Telegraph Creek Road. Development includes several active mines in the Canadian portion of the Stikine drainage and proposals for major hydroelectric projects.

Helicopter surveys of the Little Tahltan River index area have been conducted annually since 1975, and the DFO has operated a fish counting weir at the mouth of the Little Tahltan River since 1985. Since all fish spawning in the Little Tahltan River spawn above the weir, counts from the weir represent the total escapement to that tributary.

Andrew Creek flows into the lower Stikine River in Alaska, not far from the limit of tidal influence. From 1976 to 1984, a weir was operated on Andrew Creek to provide brood stock for hatcheries. Foot, aerial and helicopter surveys to count chinook salmon have been conducted annually since 1985.

The Alsek River originates in Yukon Territory, Canada, and flows in a southerly direction into the Gulf of Alaska approximately 75 km southeast of Yakutat, Alaska. Its largest tributaries are the Dezadeash and Tatshenshini rivers. The Alsek River drainage covers about 28,000 km^2 (Bigelow et al. 1995), but much of it, including the mainstem of the Alsek itself, is inaccessible to anadromous salmonids because of velocity barriers. The significant spawning areas for chinook salmon are found mostly in tributaries of the Tatshenshini River, including the Klukshu, Blanchard, and Takhanne rivers and in Village and Goat creeks. The Klukshu and upper Tatshenshini rivers are accessible by road near Dalton Post, Yukon Territory.

Counts of chinook salmon have been collected on the Alsek River since 1962. Beginning in 1976, the DFO has operated a weir at the mouth of the Klukshu to count chinook, sockeye, and coho salmon O. *kisutch*. The count of chinook salmon through the Klukshu River weir is used as the index for the Alsek River. Some aboriginal harvest takes place above the weir. Aerial surveys to count spawning chinook salmon have been conducted by ADF&G with a helicopter since 1981. Prior to 1981, counts were obtained from fixed-wing aircraft. The escapement to the Klukshu River is difficult to count by aerial, boat or foot surveys because of deep pools and overhanging vegetation. However, surveys of the Klukshu River are conducted annually to provide some continuity in estimates in case the weir is not funded.

The Unuk, Chickamin, Blossom, and Keta river drainages all feed into Behm Canal—a narrow passage of water east of Ketchikan, Alaska. Misty Fiords National Monument/ Wilderness Area surrounds the eastern or "back" Behm Canal and includes the Boca de Quadra fjords. Many of the mainland rivers in the area support chinook salmon; the Unuk, Chickamin, Blossom and Keta rivers are designated chinook salmon escapement index systems.

The Unuk River originates in a glaciated area of British Columbia and flows 129 km to Burroughs Bay 85 km northeast of Ketchikan, Alaska; only the lower 39 km of the river are in Alaska . The Unuk is a large braided, glacially occluded river with a drainage of approximately 3,885 km^2. Most (~85%) spawning occurs in tributaries of the Alaska portion of the river (Pahlke 1996). The escapement index areas are all small clear-water tributaries: Eulachon River and Cripple, Genes Lake, Clear, Lake, and Kerr creeks. Cripple Creek and Genes Lake Creek cannot be surveyed by air because of heavy vegetation, so fish are counted by foot survey. Chinook salmon have been counted annually by foot or helicopter surveys in these areas since 1977. Total escapement was estimated by a mark-recapture project in 1994 (Pahlke et al. 1996).

The Chickamin River is a large, glacial river that originates in British Columbia, and flows into Behm Canal approximately 32 km southeast of Burroughs Bay and 65 km northeast of Ketchikan. Although it is technically a transboundary river, there are no known chinook spawning areas on the Chickamin River upstream from the Canadian border. Important spawning tributaries are the South Fork of the Chickamin and Barrier, Butler, Indian, Leduc, Humpy, King, and Clear Falls creeks. Chinook salmon have been counted by foot or helicopter surveys in index areas of the Chickamin River each year since 1975. Total escapement was estimated by a mark-recapture project in 1995 and 1996 (Pahlke 1996; Pahlke in press).

The Blossom, Keta, Wilson, and Marten rivers are non-transboundary rivers that flow into Behm Canal approximately 45 km east of Ketchikan. These rivers lie inside the boundaries of the Misty Fiords National Monument in southern Behm Canal but are within an area that has been specifically excluded from Wilderness designation, due to the potential development of a large-scale molybdenum mine (Quartz Hill) near the divide of the Blossom and Keta rivers. The mine is presently undeveloped, but an access road has been completed; it terminates at salt water near the mouth of the Blossom River.

The Keta River drainage covers about 192 km^2 and the Blossom about 176 km^2 (Bigelow et al. 1995) and have been surveyed by helicopter annually since 1975. Chinook salmon escapements to the Wilson and Marten rivers have been monitored on an intermittent basis in recent years. The Marten River, the most southern of the four rivers, flows into Marten Arm near Boca de Quadra.

The King Salmon River drains an area of approximately 100 km^2 on Admiralty Island, flowing into King Salmon Bay on the eastern side of Stephens Passage about 48 km south of Juneau. The King Salmon River is the only island river system in Southeast Alaska to support a significant population of spawning chinook salmon. The only other island system with a documented run of chinook salmon is Wheeler Creek, also on Admiralty Island. The Alaska Department of Fish and Game (ADF&G) operated an upstream weir on the King Salmon River from 1983 through 1992 to count chinook salmon and collect their eggs for Snettisham Hatchery.

The Chilkat River is a large glacial river which originates in Yukon Territory, Canada, and flows into Chilkat Inlet at the head of northern Lynn Canal near Haines, Alaska. Helicopter surveys were conducted on Big Boulder Creek and Stonehouse Creek, two index areas of the Chilkat River, from 1981 to 1992 (Pahlke 1993). Counts from these streams were shown by Johnson, Marshall and Elliott (1992) to be an ineffective index of abundance, and they greatly underestimated the escapement to Chilkat River. Because all other streams in the Chilkat drainage are glacially occluded or unsuitable for other reasons, the aerial indices were suspended in favor of annual abundance estimates of escapement using mark-recapture experiments. Total escapement has been estimated annually since 1991 (Ericksen 1996).

The Situk River is located about 16 km east of Yakutat, Alaska. The Situk supports a large run of sockeye salmon *O. nerka* which are harvested in commercial and subsistence set gill net fisheries concentrated at the mouth of the Situk River. Situk River chinook salmon are harvested both incidentally and targeted in the set gill net fisheries, depending on run strength and in a recreational fishery in the river. A weir was operated on the Situk River at the upper limit of the intertidal area from 1928 to 1955 to count all five species of Pacific salmon spawning in the river. From 1976 to 1987, a weir was operated further upstream near the Nine Mile Road bridge, primarily to count chinook and sockeye salmon. In 1988, the weir was returned to a location near tidewater and is operated jointly by the Division of Sport Fish and Commercial Fisheries Management and Development Division (CFMD) of ADF&G. Approximately 30% of the recreational harvest occurs above the weir (Howe et al. 1997).

METHODS

There are 34 river systems in the region (Figure 1) with populations of wild chinook salmon. Three transboundary rivers, the Taku, Stikine, and Alsek, are classed as major producers—each with potential production (harvest plus escapement) greater than 10,000 fish. Nine rivers are classed as medium producers, each with production of 1,500 to 10,000 fish. The remaining 22 rivers are minor producers, with production less than 1,500 fish. Small numbers of chinook salmon occur in other streams of the region but they are not included in the above because successful spawning has not been documented. Chinook salmon are counted via aerial surveys or at weirs each year in all three major producing systems, in six of the medium producers, and in one minor producer (Appendix A1).

Escapement Goals

The initial rebuilding program established minimum escapement goals for 9 systems including the transboundary Alsek, Taku, and Stikine Rivers. Although the aim was to have escapement goals that provided the optimal level of harvest, little data was available to produce such estimates. As a result, escapement goals were originally set in 1981 based on past observed levels of escapement in index tributaries multiplied by expansion factors to

account for the proportion of spawners thought to be observed in surveys and the proportion of the entire system represented by the index tributary (Appendix B1). Escapement goals have been revised when sufficient new information warrants.

INDICES OF ESCAPEMENT

Spawning chinook salmon are counted at 26 designated index areas in nine of the systems; complete counts of chinook salmon are obtained at the Situk River weir. Counts are made during aerial or foot surveys or at weirs. Aerial surveys are conducted from a Bell 206 or Hughes 500D helicopter during periods of peak spawning. Peak spawning times, defined as the period when the largest number of adult chinook salmon actively spawn in a particular stream or river, are well-documented from surveys of these index areas conducted over the past 21 years (Kissner 1982). The proportion of fish in pre-spawning, spawning and post-spawning condition is used to judge whether the survey timing is correct to encompass peak spawning.

Index areas are surveyed at least twice unless turbid water or unsafe flying conditions preclude the second survey. Pilots are directed to fly the helicopter from 6 to 15 meters above the river bed at a speed of 6–16 km/h. The helicopter door on the side of the observer is removed, and the helicopter is flown sideways while observations of spawning chinook salmon are made from the open space.

Foot surveys are conducted by at least two people walking in the creek bed or on the riverbank. Only large (typically age-.3, -.4, and -.5) chinook salmon, $\geq$660 mm mideye-to-fork length (MEF), are counted during aerial or foot surveys. No attempt is made to accurately count small (typically age-.1 and -.2) chinook salmon <660 mm (MEF) (Mecum 1990). These small chinook salmon, also called jacks, are early maturing, precocious males considered to be surplus to spawning escapement needs. They are easy to separate visually from their older age counterparts under most conditions, because of their short, compact bodies and lighter color. They are, however, difficult to distinguish from other smaller species such as pink *O. gorbuscha* and sockeye salmon.

Counts and other observations from the 1996 surveys (Appendix A3) are entered into the ADF&G CFMD Integrated Fisheries Database (IFDB) in Juneau for archiving and general distribution.

Estimates of total escapement are needed to model total production, exploitation rates and other population parameters. To estimate escapement (since indices are only a partial count of spawning abundance), counts from index areas are expanded by a "survey expansion factor" and/or a "tributary expansion factor" (Appendix A1). A survey expansion factor is a judgment as to the proportion of the total season's escapement counted in the specific area observed during the peak spawning period. Survey expansion factors are based on comparisons with weir counts, mark-recapture estimates, and spawning distribution studies or by professional judgment. They vary among index areas according to the difficulties encountered in observing spawners, such as overhanging vegetation, turbid water conditions, presence of other salmon species (i.e., pink and chum *O. keta* salmon), or protraction of run timing. Survey expansion factors range from 1.5× for the King Salmon River to 4× for most other index areas (Appendix A1).

Escapement counts are also obtained from fish-counting weirs operated by the DFO on the Little Tahltan (Stikine), Tatsamenie (Taku), and Klukshu (Alsek) rivers, by the TRTN on the Nahlin and Nakina rivers (Taku), and by ADF&G on the Situk River. Survey expansions are not necessary for those streams where weirs or other estimation programs are used to count all migrating chinook salmon.

Peak aerial, foot, or weir counts are also expanded by a "tributary expansion factor," a judgment as to the proportion of spawners observed in index areas relative to the escapement to the entire drainage (i.e., not all tributaries or spawning areas were surveyed). Tributary expansion factors range from 4× for the Stikine River to 1.5625× for the Klukshu River (Appendix A1).

Finally, to estimate total regional escapement, counts are additionally expanded by a "category expansion factor" which weights expanded counts from major, medium, and minor producers by the number of streams in each category in the region. These factors are 3/3 for large systems, 9/7 for medium systems and 22/1 for small systems (Appendix A1).

Expansion factors for individual rivers have been revised, based on results from experiments to estimate total escapement and spawner distribution. For example, radio-tracking distribution data were used to revise tributary expansion factors for the Taku and Unuk rivers (PSC 1991; Pahlke et al. 1996; McPherson et al. 1996 and McPherson et al. 1997). Mark-recapture studies to estimate spawning abundance on the Unuk River in 1994 (Pahlke et al. 1996) and on the Chickamin River in 1995 (Pahlke 1996, Pahlke *in press.*) were used to revise expansion factors for those two rivers in 1996; results were also applied to the nearby Blossom and Keta rivers. On Andrew Creek, a weir was operated in four years (1979, 1981, 1982, and 1984), during which index counts were also made, establishing a new expansion factor for that system in 1995. Also in 1995, ten years (1983–1992) of matched weir and index counts were used to confirm the expansion factor for the King Salmon River. The expansion factors for the Taku River were revised in 1996 based on the results of four years of mark-recapture studies (Pahlke and Bernard 1996, McPherson et al. 1997).

These studies have helped to estimate total escapement in the region and have shown that, in most cases, the surveyed index areas provide reasonably accurate trends in escapements. However, Johnson et al. (1992) demonstrated that expansion factors used on the Chilkat River system were highly inaccurate, because the index areas received less than 5% of the escapement. Since 1991, escapement to the Chilkat River has been estimated annually by mark-recapture experiments (Ericksen, *In press*). Studies on the Taku, Unuk, Chickamin, and King Salmon rivers, as well as on Andrew Creek, have shown that the index expansion factors used on those systems were much more accurate than those used on the Chilkat (PSC 1991, Pahlke 1996, Pahlke *in press*). Expansion factors will continue to be revised as additional data become available.

Ongoing research projects should provide more information on the expansion factors for the Taku, Stikine, Chilkat, Unuk, and Alsek rivers, and Andrew Creek. Estimates of escapement from expanded counts are included in this document to provide gross figures of spawner abundance, with the caveat that expansion factors may produce incorrect estimates in some cases.

RESULTS

From 1984 to 1993, the estimated escapement of chinook salmon in Southeast Alaska increased steadily for 10 years and exceeded the sum of escapement goals for all systems for the first time in 1993 (Figure 2). This was due primarily to strong returns to the Taku, Stikine, and Chilkat rivers, which together make up 74% of the regional escapement goal.

In 1996, 44 locations, 26 of which were designated index areas, were surveyed specifically for chinook salmon escapement (Appendix A3). Surveys generally progressed as planned, but poor water conditions and record escapements of chum salmon hampered surveys in the Behm Canal systems.

The estimated escapement (expanded) of chinook salmon for all Southeast Alaska and transboundary rivers was 128,686 (Table 1), an 65% increase from the estimated 78,226 fish in 1995. This was due primarily to a record high escapement to the Taku River, one of the two largest stocks in the region. The 1996 escapement is over 3 times the 1975–1980 base period average of 40,949 chinook salmon, twice the 1981–1985 average of 63,580, and 149% of the 1986–1990 average of 86,474 fish (Appendix A2).

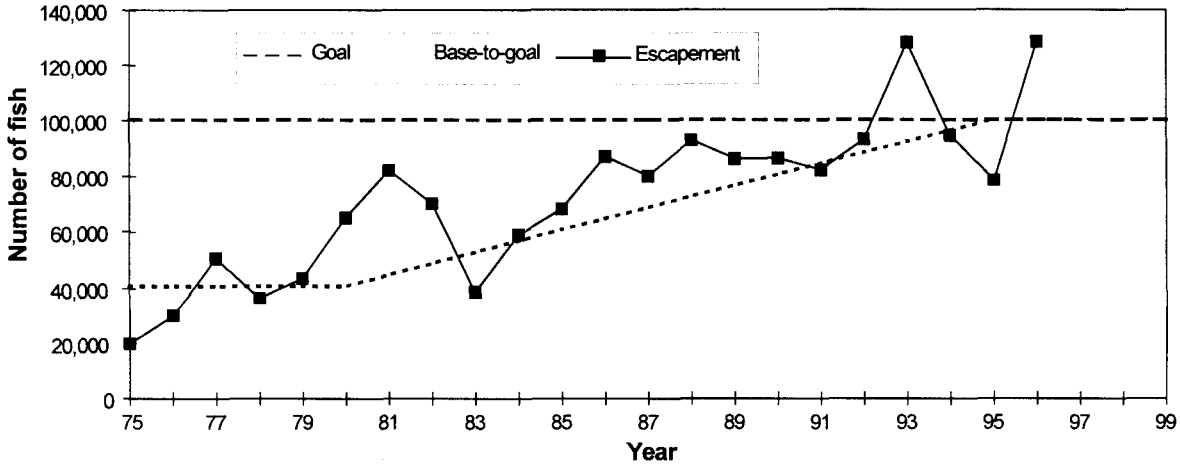

Figure 2.–Estimated total escapement of large chinook salmon to Southeast Alaska and transboundary rivers, 1975–1996. Spawner counts are expanded by survey, tributary, and category expansion factors. Base-to-goal line represents desired rebuilding rate, starting in 1981 at the average escapement during base period (1975–1980) and ending at a management escapement goal of 100,320 large chinook salmon in 1995 (final year of the three-cycle rebuilding program).

Table 1.–Estimated escapement of chinook salmon to Southeast Alaska and transboundary rivers in 1996.

	Survey area	Number counted	Survey expansion factor	Tributary expansion factor	Estimated inriver escapement	Category expansion factor	Final estimated escapement
Major producers							
Alsek River	Klukshu	3,382 [a]	1×	1.5625×	5,284		4,401[b]
Taku River	6 tributaries	19,777	4X[c]	1×	79,108		
Stikine River	Little Tahltan	4,840	1×	4×	19,360		
Category subtotal					103,752	3/3	102,869
Medium producers							
Situk River	all	2,175	–	1×	1,913 [d]		
Chilkat River	all	4,920	–	1×	4,920		
Andrew Cr.	all	335	2X [e]	1×	670		
Unuk River	all	1,167	4X [e]	1×	4,668		
Chickamin River	all	422	4X [e]	1×	1,688		
Blossom River	all	220	2.5X [e]	1×	550		
Keta River	all	297	2.5X [e]	1×	743		
Category subtotal					15,152	9/7	19,481
Minor producers							
King Salmon R.	all	192	1.5X	1×	288		
Category subtotal					288	22/1	6,336
Total							128,686

[a] Klukshu weir count minus above weir IFF and broodstock removal (217).

[b] Estimated escapement reduced by 233 IFF and 650 sport fish harvest below weir.

[c] Revised in 1997 (McPherson et al. 1996)

[d] Situk River weir count minus estimated sport harvest above weir.

[e] Revised in 1996 (McPherson and Carlile 1997).

TAKU RIVER

The count of 19,777 large chinook salmon in the six index areas of the Taku River was the highest on record (Table 2). The counts in all six tributaries were above average with record highs in 4 of them (Table 3). Counts have increased steadily from 1983 to 1993, meeting the revised six-tributary escapement goal (PSC 1991) of 13,210 fish for the first time in 1993 and exceeding the goal in 1996 (Figure 3). Counts were below the goal in 1994 and 1995.

Counts were expanded by a survey expansion factor of 4. The expansion factor was revised in 1996 based on research on the Taku River which indicates the prior expansion factors underestimate the actual escapement of chinook salmon by as much as 30% (Pahlke and Bernard 1996; McPherson et al. 1996).

Expansion factors for the Taku River were previously modified in 1991 on the basis of results from a 2-year tagging study which produced new information on the distribution of spawners in the drainage (PSC 1991). However, these changes were not adopted by the Transboundary River Technical Committee (TBTC) of the PSC, who revised the escapement goal to be composed of the sum of counts from all six index tributaries (PSC 1991). The PSC goal uses no expansion factors but refers to chinook salmon actually counted during surveys.

STIKINE RIVER

At the Little Tahltan River weir 4,840 chinook salmon were counted in 1996. The 1996 weir count was 49% higher than the count of 3,259 in 1995 and below the 1986 - 1995 average of 5,634 (Table 4). An aerial survey of Beatty Creek counted 218 large chinook salmon, down considerably from the record count of 757 in 1993 (Table 4). The count in the glacially occluded mainstem Tahltan River was 772 fish, also considerably below the 1986–95 average of 2,074.

Two aerial surveys flown in 1995 obtained counts of 1,784 and 1,920 large chinook salmon above the Little Tahltan River weir. The peak survey count was 39.7% of the total escapement through the weir. From 1985 to 1995, the proportion of the total escapement of chinook salmon counted during peak aerial surveys has ranged from 35.0% to 56.6% and averaged 44.6% (Table 5). The proportion of the total escapement observed in a single survey often declined after the peak of spawning as fish died or were removed by predators.

The revised escapement goal (PSC 1991) for the Little Tahltan River weir is 5,300 fish. The 1996 weir count fell below that goal for the second year since 1991, and, for the second time since 1986, fell below the rebuilding schedule (Figure 4). Expansion of the 1996 Little Tahltan weir count of 4,840 large chinook salmon by the tributary expansion factor (4X) produced a total Stikine River escapement estimate of 19,360 large chinook salmon.

ANDREW CREEK

The count of chinook salmon in Andrew Creek was 335 fish, similar to 343 in 1995 (Table 6). This was the only the third year since 1985 that the Andrew Creek escapement did not exceed the index goal of 470 fish (Figure 5). From 1976 to 1984 a weir was operated on Andrew Creek to provide brood stock for hatcheries. Total spawners removed from the creek ranged from 12 in 1978 to 275 in 1982 (Pahlke 1995). Surveys were also conducted on the system four of those years and, on the basis of those paired counts, the survey expansion factor was revised in 1995 from 1.6 (1/.625) to 2 (see Table 1). The expanded total escapement goal remains 750 fish. No survey expansion was necessary for years when the weir provided total escapement counts (Appendix A2).

Table 2.–Counts of spawning chinook salmon in index areas of the Taku River, 1951–1996.

Year[a]	Nakina River	Nahlin River	Kowatua River	Tatsamenie River	Dudidontu River	Tseta Creek	Total
1951	5,000 (F)[b]	1,000	–	–	400 (F)	100 (F)	6,500
1952	9,000 (F)	–	–	–	–	–	9,000
1953	7,500 (F)	–	–	–	–	–	7,500
1954	6,000 (F)	– (F)	–	–	–	–	6,000
1955	3,000 (F)	–	–	–	–	–	3,000
1956	1,380 (F)	–	–	–	–	–	1,380
1957	1,500 (F/W)	–	–	–	–	–	1,500 [c]
1958	2,500 (F/W)	2,500 (A)	–	–	4,500 (A)	–	9,500 [c]
1959	4,000 (F/W)	–	–	–	–	–	4,000 [c]
1962	–	216 (A)	–	–	25 (A)	81 (A)	322
1965	3,050 (H)	35 (A)	200 P(A)	50 P(A)	110 (A)	18 (A)	3,463
1966	3,700 P(A)	300 (A)	14 P(A)	100 P(A)	252 (A)	150 (A)	4,516
1967	700 (A)	300 P(A)	250 P(A)	–	600 (A)	350 (A)	2,200
1968	300 P(A)	450 (A)	1,100 (A)	800 E(A)	590 (A)	230 (A)	3,470
1969	3,500 (A)	–	3,300 (A)	800 E(A)	–	–	7,600
1970	–	26 (A)	1,200 P(A)	530 E(A)	10 (A)	25 (A)	1,791
1971	500 (A)	473 (A)	1,400 E(A)	360 E(A)	165 (A)	– (A)	2,898
1972	1,000 (F)	280 (A)	170 (A)	132 (A)	102 (A)	80 P(A)	1,764
1973	2,000 N(H)	300 E(H)	100 N(H)	200 E(H)	200 E(H)	4 (A)	2,804
1974	1,800 E(H)	900 E(H)	235 (A)	120 (A)	24 (A)	4 (A)	3,083
1975	1,800 E(H)	274 E(H)	–	–	15 N(H)	–	2,089
1976	3,000 E(H)	725 E(H)	341 P(A)	620 E(H)	40 (H)	–	4,726
1977	3,850 E(H)	650 E(H)	580 E(A)	573 E(H)	18 (H)	–	5,671
1978	1,620 E(H)	624 E(H)	490 N(H)	550 E(H)	–	21 E(H)	3,305
1979	2,110 E(H)	857 E(H)	430 N(H)	750 E(H)	9 E(H)	–	4,156
1980	4,500 E(H)	1,531 E(H)	450 N(H)	905 E(H)	158 E(H)	–	7,544
1981	5,110 E(H)	2,945 E(H)	560 N(H)	839 E(H)	74 N(H)	258 N(H)	9,786
1982	2,533 E(H)	1,246 E(H)	289 N(H)	387 N(H)	130 N(H)	228 N(H)	4,813
1983	968 E(H)	391 N(H)	171 E(H)	236 E(H)	117 E(H)	179 N(H)	2,062
1984	1,887 (H)	951 (H)	279 E(H)	616 E(H)	–	176 (H)	3,909
1985	2,647 N(H)	2,236 E(H)	699 E(H)	848 E(H)	475 (H)	303 E(H)	7,208
1986	3,868 (H)	1,612 E(H)	548 E(H)	886 E(H)	413 E(H)	193 E(H)	7,520[d]
1987	2,906 E(H)	1,122 E(H)	570 E(H)	678 E(H)	287 E(H)	180 E(H)	5,743
1988	4,500 E(H)	1,535 E(H)	1,010 E(H)	1,272 E(H)	243 E(H)	66 E(H)	8,626
1989	5,141 E(H)	1,812 E(H)	601 (W)	1,228 E(H)	204 E(H)	494 E(H)	9,480
1990	7,917 E(H)	1,658 E(H)	614 (W)	1,068 N(H)	820 E(H)	172 N(H)	12,249
1991	5,610 E(H)	1,781 E(H)	570 N(H)	1,164 E(H)	804 E(H)	224 N(H)	10,153[e]
1992	5,750 E(H)	1,821 E(H)	782 E(H)	1,624 N(H)	768 N(H)	313 N(H)	11,058[e]
1993	6,490 E(H)	2,128 N(H)	1,584 E(H)	1,491 E(H)	1,020 E(H)	491 N(H)	13,204
1994	4,792 N(H)	2,418 E(H)	410 P(H)	1,106 N(H)	573 N(H)	614 E(H)	9,913
1995	3,943 E(H)	2,069 E(H)	550 N(H)	678 N(H)	731 E(H)	786 E(H)	8,757
1996	7,720 E(H)	5,415 E(H)	1,620 N(H)	2,011 N(H)	1,810 N(H)	1,201 N(H)	19,777
86-95 Avg	5,092	1,796	724	1,119	586	353	9,670

[a] Counts before 1975 may not be comparable due to changes in survey dates and methods. Early foot surveys may have included jacks.

[b] (F) = foot survey, — = no survey conducted, (A) = fixed-wing aircraft, (H) = helicopter, P = survey conditions hampered by glacial or turbid waters, N = normal water flows and turbidity–average survey conditions, E = survey conditions excellent.

[c] Partial survey of Nakina River in 1957–59; comparisons made from carcass weir counts.

[d] Surveys in 1984 conducted by DFO; partial survey of Tseta Creek and Nahlin.

[e] Carcass weir at Kowatua River used to partially count escapement due to unfavorable water conditions.

Table 3.–Distribution of spawning chinook salmon among index areas of the Taku River during years when all index areas were surveyed.

Year	Nakina River	%	Nahlin River	%	Kowatua River	%	Tatsamenie River	%	Dudidontu River	%	Tseta Creek	%	Total
1981	5,110	52	2,945	30	560	6	839	9	74	1	258	3	9,786
1982	2,533	53	1,246	26	289	6	387	8	130	3	228	5	4,813
1983	968	47	391	19	171	8	236	11	117	6	179	9	2,062
1985	2,647	37	2,236	31	699	10	848	12	475	7	303	4	7,208
1986	3,868	51	1,612	21	548	7	886	12	413	5	193	3	7,520
1987	2,906	51	1,122	20	570	10	678	12	287	5	180	3	5,743
1988	4,500	52	1,535	18	1,010	12	1,272	15	243	3	66	1	8,626
1989	5,141	54	1,812	19	601	6	1,228	13	204	2	494	5	9,480
1990	7,917	65	1,658	14	614	5	1,068	9	820	7	172	1	12,249
1991	5,610	55	1,781	18	570	6	1,164	11	804	8	224	2	10,153
1992	5,750	52	1,821	16	782	7	1,624	15	768	7	313	3	11,058
1993	6,490	49	2,128	16	1,584	12	1,491	11	1,020	8	497	4	13,210
1994	4,792	48	2,418	24	410	4	1,106	11	573	6	614	6	9,913
1995	3,943	45	2,069	24	550	6	678	8	731	8	786	9	8,757
Avg.	4,660	52	2,013	20	705	8	1,034	11	565	5	380	4	9,357
1996	7,720	39	5,415	27	1,620	8	2,011	10	1,810	9	1,201	6	19,777

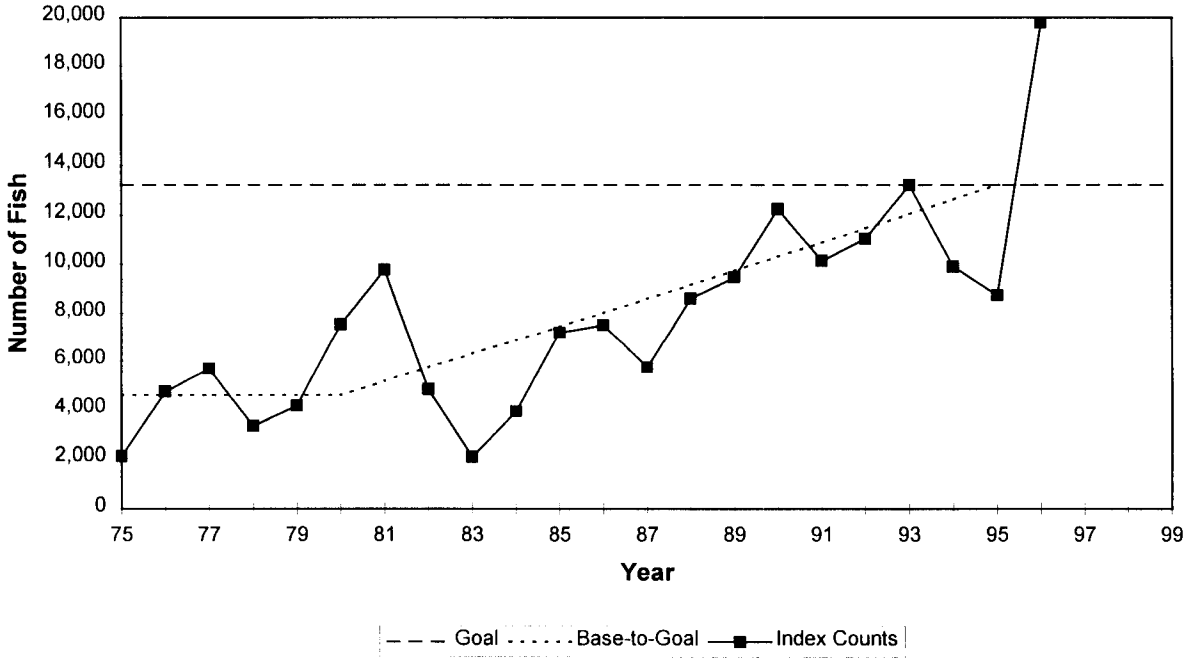

Figure 3.–Counts of chinook salmon in index areas of the Taku River, 1975–1996. Base-to-goal line indicates linear rebuilding schedule, starting in 1981 at average escapement level during the base period (1975–1980) and ending at revised escapement goal of 13,200 large chinook salmon in 1995 (final year of the three-cycle rebuilding program.)

Table 4.–Counts of spawning chinook salmon in index areas of the Stikine River, 1975–1996.

Year[a]	Little Tahltan River Survey count	Little Tahltan River Weir count	Mainstem Tahltan River	Beatty Creek	Total
1975	700 E(H)	–	2,908 E(H)	–	3,608
1976	400 N(H)	–	120 (H)	–	520[d]
1977	800 P(H)	–	25 (A)	–	825
1978	632 E(H)	–	756 P(H)	–	1,388
1979	1,166 E(H)	–	2,118 N(H)	–	3,284
1980	2,137 N(H)	–	960 P(H)	122 E(H)	3,219
1981	3,334 E(H)	–	1,852 P(H)	558 E(H)	5,744
1982	2,830 N(H)	–	1,690 N(F)	567 E(H)	5,087
1983	594 E(H)	–	453 N(H)	83 E(H)	1,130
1984	1,294 (H)	–	–	126 (H)	1,420[e]
1985	1,598 E(H)	3,114	1,490 N(H)	147 N(H)	4,751[f]
1986	1,201 E(H)	2,891	1,400 P(H)	183 N(H)	4,474
1987	2,706 E(H)	4,783	1,390 P(H)	312 E(H)	6,485
1988	3,796 E(H)	7,292	4,384 N(H)	593 E(H)	12,269
1989	2,527 E(H)	4,715	–	362 E(H)	5,077
1990	1,755 E(H)	4,392	2,134 N(H)	271 E(H)	6,797
1991	1,768 E(H)	4,506	2,445 N(H)	193 N(H)	7,144
1992	3,607 E(H)	6,627	1,891 N(H)	362 N(H)	8,880
1993	4,010 P(H)	11,449	2,249 P(H)	757 E(H)	14,455
1994	2,422 N(H)	6,450[g]	–	184 N(H)	6,610
1995	1,117 N(H)	3,259	696 E(H)	152 N(H)	4,107
86-95 Avg	2,491	5,634	2,074	337	8,045
1996	1,920 N(H)	4,840	772 N(H)	218 N(H)	5,830

[a] Counts prior to 1975 may not be comparable because of differences in survey dates and counting methods.

[b] (F) = foot survey; N = normal survey conditions; (A) = survey conducted by fixed-wing aircraft; (H) = helicopter survey; P = survey conditions hampered by glacial or turbid waters; E = excellent survey conditions; — = no survey conducted or data not comparable.

[c] Chinook lifted over barrier on Tahltan, 1965 and 1966.

[d] Late count on mainstem Tahltan, minimal estimate.

[e] Surveys done by DFO in 1984.

[f] Total = Little Tahltan weir count plus aerial or weir counts on other systems, 1985-present.

[g] Total count of 6,450 was reduced to 6,426 actual spawners by an egg take of 26 fish.

Table 5.–Comparison of peak aerial survey counts of chinook salmon to final counts at the Little Tahltan River weir, 1985–1996.

Year	Weir count[a]	Count from aerial survey[b]	Percent counted in survey
1985	3,114	1,598	51.3%
1986	2,891	1,201	41.5%
1987	4,783	2,706	56.6%
1988	7,292	3,796	52.1%
1989	4,715	2,527	53.6%
1990	4,392	1,755	40.0%
1991	4,506	1,768	39.2%
1992	6,627	3,607	54.4%
1993	11,449	4,010	35.0%
1994	6,426	2,422	37.7%
1995	3,259	1,117	34.3%
1996	4,840	1,920	39.7%
Average	5,405	2,410	44.6%

[a] Weir count minus egg takes.

[b] Final count equals peak survey above weir plus count below weir on that date.

ALSEK RIVER

The count of large chinook salmon through the Klukshu River weir in 1996 was 3,599 fish, 63% of the record escapement of 5,678 in 1995 (Table 7). The escapement to the Klukshu, estimated by subtracting the Indian Food Fishery (IFF) harvest above the weir (215) and brood stock removal (2) from the weir count, was 3,382 fish, 28% below the escapement goal of 4,700. All of the sport harvest (650 fish) was below the weir. The 1996 peak aerial counts of large chinook salmon were 230 in Takhanne River, 132 in the Blanchard River and 12 Goat Creek .

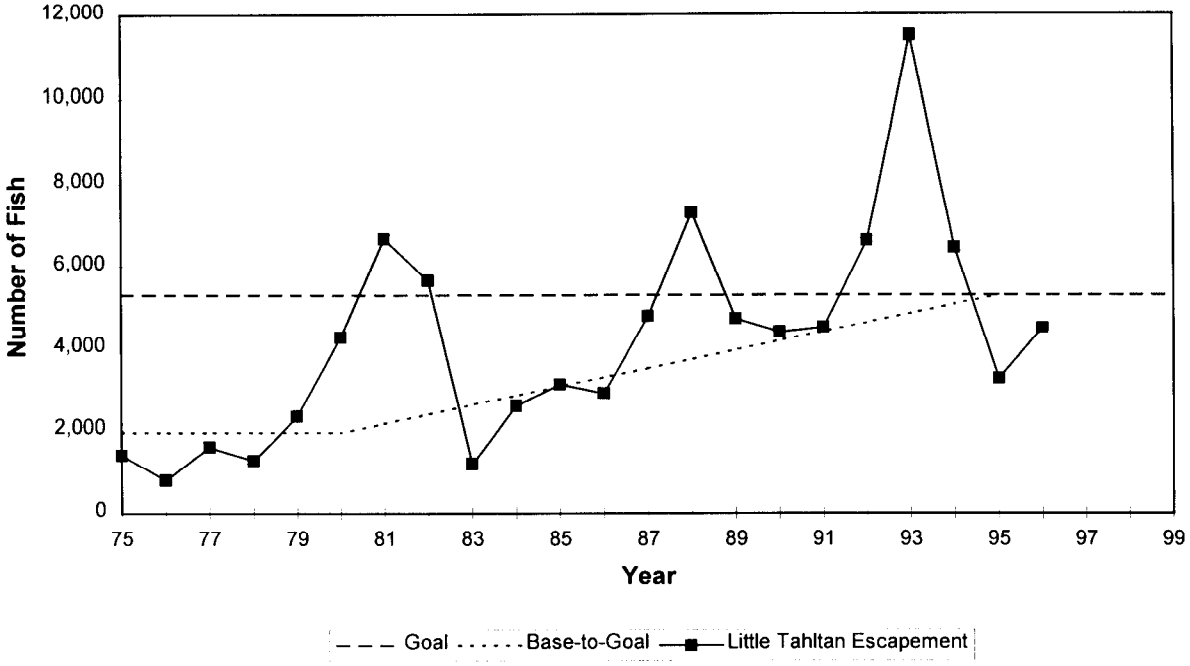

Figure 4.–Counts of chinook salmon at the Little Tahltan River weir, Stikine River, 1975–1996 Base-to-goal line shows linear rebuilding schedule, starting in 1981 at average escapement level during base period (1975–1980) and ending at escapement goal of 5,300 large chinook salmon in 1995 (final year of the three-cycle rebuilding program).

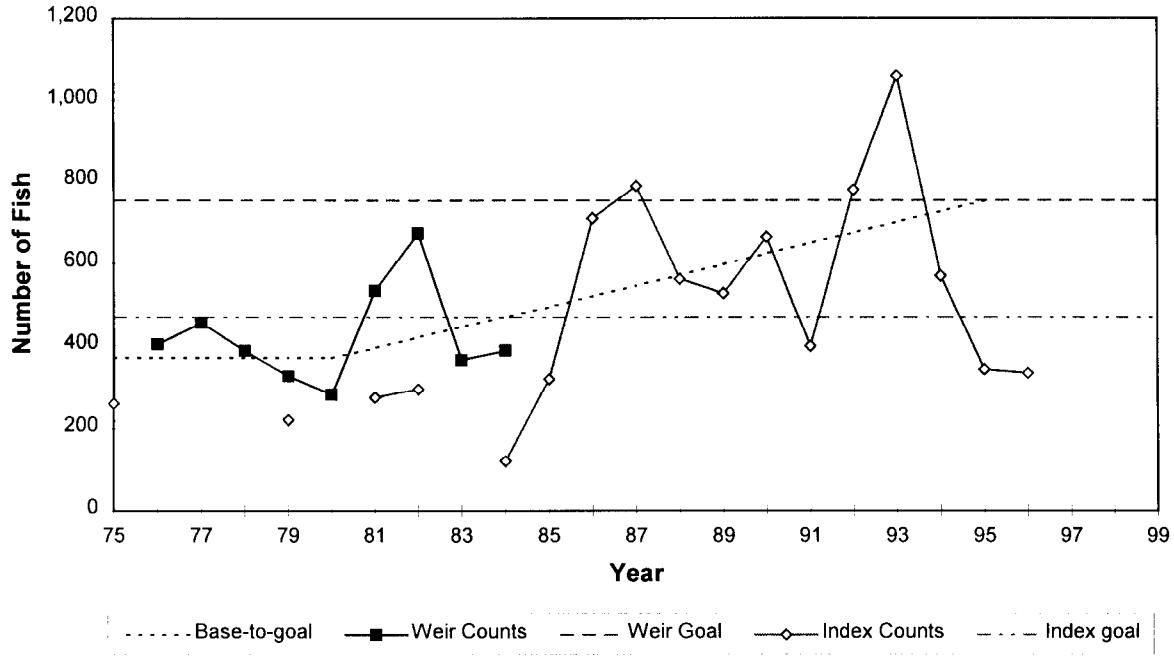

Figure 5.–Counts of chinook salmon at the Andrew Creek weir (1976–1984) and in aerial/foot surveys, 1975, 1985–1996. Base-to-goal line shows linear rebuilding schedule, starting in 1981 at average escapement level during base period (1975–1980) and ending at escapement goal of 750 large chinook salmon in 1995 (final year of the three-cycle rebuilding program)

Table 6.–Counts of spawning chinook salmon in selected rivers in central Southeast Alaska, 1956–1996

Year	Andrew Creek[a]		North Arm		Clear Creek		Harding River		Aaron Creek		Bradfield River	
											N. Fork	E. Fork
1956	4,500	(A)[b]	–		–		–		–		–	–
1957	3,000	(F/A)	–		–		–		–		–	–
1958	2,500	(F/A)	–		–		–		–		–	–
1959	150	(F/A)	–		–		–		–		–	–
1960	287	(F)	200	(F)N	–		–		–		–	–
1961	103	(F)	138	(F)	–		–		–		–	–
1962	300	(A)	80	(A)N	–		–		–		–	–
1963	500	(A/H)	187	(F)	–		–		–		–	–
1964	400	(H)	–		–				–		–	–
1965	100	(A)	–		–		25		–		–	–
1966	75	(A)	–		–		–		–		–	–
1967	30	(A)	–		–		–		–		–	–
1968	15	–	–		–		–		–		–	–
1969	12	(A)	–		–		–		–		–	–
1970	0	–	–		–		–		–		–	–
1971	305	(A)	–		–		–		–		–	–
1972	0	–	–		–		–		–		–	–
1973	40	(A)	–		–		10		–		–	–
1974	129	(A)	–		–		35		–		–	–
1975	260	(F)	–		–		–		–		–	–
1976	404	(W/F)	–		–		12	(A)N	24		–	13
1977	456	(W/F)	–		–		410	(A)E			–	
1978	388	(W/F)	24	(F)E	–		12	(H)N	–		–	63
1979	327	(W/F)	16	(F)E	–		–		–		–	10
1980	282	(W/F)	68	(F)N	–		–		–		30	–
1981	536	(W/F)	84	(F)E	4	(F)P	28	(H)P	12		84	–
1982	672	(W/F)	138	(F)N	188	(F)N	8	(A)E	–			–
1983	366	(W/F)	15	(F)N	–		15	(A)P	–		55	–
1984	389	(W/F)	31	(F)N	–		35	(B)N	–		–	–
1985	320	(F)E	44	(F)E	–		243	(F)N	179		58	85
1986	708	(F)N	73	(F)N	45	(A)E	240	(B)N	178		104	215
1987	788	(H)E	71	(F)E	122	(F)N	40	(A)E	51		186	175
1988	564	(F)N	125	(F)N	167	(F)N	70	(A)P	325		680	410
1989	530	(F)E	150	(A)N	49	(H)N	80	(A)P	135		193	132
1990	664	(F)E	83	(F)N	33	(H)P	24	(A)P	–		–	–
1991	400	(A)N	38	(A)N	46	(A)N	42	(F)N	–		81	320
1992	778	(H)E	40	(F)E	31	(A)N	48	(A)P	30		–	–
1993	1,060	(F)E	53	(F)E	–		40	(A)N	–		33	118
1994	572	(H)E	58	(F)E	10	(A)N	87	(H)N	27		15	–
1995	343	(A)P	28	(A)P	1	(A)E	38	(H)N	65		16	43
1996	335	F(N)	35	F(N)	21	A(N)	75	(A)N	15	H	78	48

[a] Andrew Creek total return equals sum of weir count, counts below weir, and on North Fork, minus egg take, 1976–1984.

[b] (A) = survey conducted by fixed -wing aircraft; — = no survey conducted or data not comparable; (F/A) = combined foot and aerial count; (F) = survey conducted by walking; (H) = survey conducted by helicopter; (W/F) = weir and foot count; N = normal survey conditions; E = excellent survey conditions; P = poor survey conditions; (B) = escapement surveyed from boat.

Table 7.–Escapement of chinook salmon to the Klukshu River and counts of spawning adults in other tributaries of the Alsek River, 1962–1996.

	Klukshu River												
	Aerial	Weir	Above-weir harvest			Escape-	Blanchard		Takhanne		Goat		
Year[a]	count	count	IFF	Sport	Brood	ment[b]	River		River		Creek		Total[c]
1962	86	–	–	–		86	–[d]		–		–		86
1963	–	–	–	–		–	–		–		–		0
1964	20	–	–	–		20	–		–		–		20
1965	100	–	–	–		100	100		250		–		450
1966	1,000	–	–	–		1,000	100		200		–		1,300
1967	1,500	–	–	–		1,500	200		275		–		1,975
1968	1,700	–	–	–		1,700	425		225		–		2,350
1969	700	–	–	–		700	250		250		–		1,200
1970	500	–	–	–		500	100		100		–		700
1971	300	–	–	–		300	–		–		–		300
1972	1,100	–	–	–		1,100	12	(A)	250		–		1,362
1973	–	–	–	–		–	–		49	(A)	–		49
1974	62	–	–	–		62	52	(A)	132		–		246
1975	58	–	–	–		58	81	(A)	177	(A)	–		316
1976	–	1,278	150	64		1,064	–		–		–		1,064
1977	–	3,144	350	96		2,698	–		–		–		2,698
1978	–	2,976	350	96		2,530	–		–		–		2,530
1979	–	4,404	1,300	0		3,104	–		–		–		3,104
1980	–	2,673	150	0		2,487	–		–		–		2,487
1981	–	2,113	150	0		1,963	35	(H)	11	(H)	–		2,009
1982	633	2,369	400	0		1,969	59	(H)	241	(H)	13	(H)	2,282
1983	917	2,537	300	0		2,237	108	(H)	185	(H)	–		2,530
1984	–	1,672	100	0		1,572	304	(H)	158	(H)	28	(H)	2,062
1985	–	1,458	175	0		1,283	232	(H)	184	(H)	–		1,699
1986	738	2,709	102	0		2,607	556	(H)	358	(H)	142	(H)	3,663
1987	933	2,616	125	0		2,491	624	(H)	395	(H)	85	(H)	3,595
1988	–	2,037	43	0		1,994	437	E(H)	169	E(H)	54	E(H	2,654
1989	893	2,456	234	0	20	2,202	–		158	E(H)	34	E(H	2,394
1990	1,381	1,915	202	0	15	1,698	–		325	E(H)	32	E(H	2,055
1991	–	2,489	241	0	25	2,223	121	N(H)	86	E(H)	63	E(H	2,493
1992	261	1,367	88	0	36	1,243	86	P(H)	77	N(H)	16	N(H	1,422
1993	1,058	3,303	64	0	18	3,221	326	N(H)	351	E(H)	50	N(H	3,948
1994	1,558	3,727	99	0	8	3,620	349	N(H)	342	E(H)	67	N(H	4,378
1995	1,053	5,678	260	0	21	5,397	338	P(H)	260	P(H)	–		5,995
86–95 average	984	2,830	146	0	20	2,670	355		252		60		3,337
1996	788	3,599	215	0	2	3,382	132	N(H)	230	N(H)	12	N(H	3,756

[a] Escapement counts prior to 1975 may not be comparable due to differences in survey dates and counting methods.

[b] Klukshu River escapement = weir count minus Indian Food Fishery (IFF) and broodstock.

[c] Total = Klukshu escapement plus aerial counts of other systems.

[d] — = no survey; (A) = aerial survey from fixed wing aircraft; (H) = helicopter survey; E = excellent survey conditions; N = normal conditions; P = poor conditions.

The estimated escapement for the entire Alsek River drainage, obtained by expanding the count from the Klukshu River weir minus broodstock removal by 1.5625× (tributary expansion factor) and subtracting sport harvest (650) and IFF harvest (223) below the weir, was 4,401 large chinook salmon. Average escapements of chinook salmon to the Alsek River during the first two cycles of the rebuilding program (1981–1985 and 1986–1990) actually declined, relative to the 1975–1980 base period (Figure 6). In 1991, the TBTC revised the Alsek River chinook escapement goal to 4,700 fish

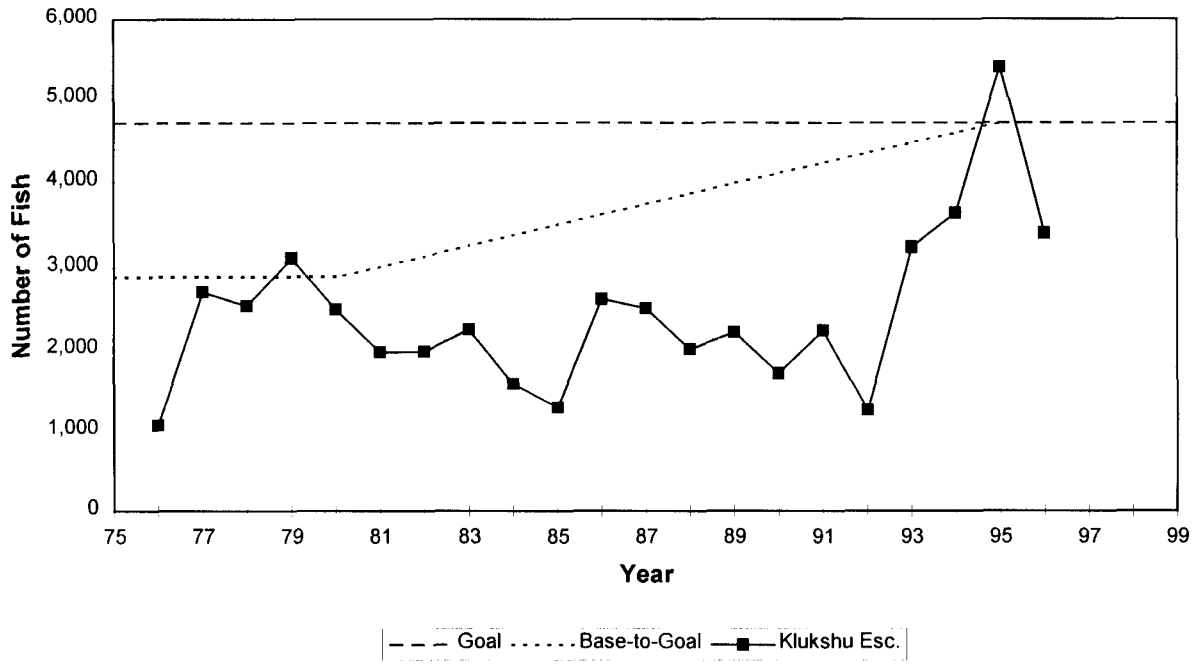

Figure 6.–Escapement of chinook salmon to the Klukshu River tributary of the Alsek River, 1975–1996 Base-to-goal line indicates linear rebuilding trend, starting in 1981 at average escapement level during base period (1975–1980) and ending at the escapement goal of 4,700 large chinook salmon in 1995 (final year of three-cycle rebuilding program).

through the Klukshu River weir (PSC 1991). There is no agreement on use of new expansion factors; therefore the total escapement was estimated using the above methods. The only time the escapement goal or rebuilding schedule has ever been exceeded was 1995.

UNUK RIVER

In 1996, 1,167 large chinook salmon were counted in index areas of the Unuk River (Table 8)—a count that was below average in 3 out of 6 index areas (Table 9). The total count was 33% above the survey goal (revised in 1996) of 875 fish, range 650 to 1,400 (McPherson and Carlile, 1997).

Boundary Creek was not surveyed in 1996, a change in the river between 1991 and 1994, which had revealed more spawning than previously observed area in that tributary, has again changed, resulting in low counts. Boundary Creek is not part of the Unuk River index area and was not included in summed counts for the watershed nor in the expanded count.

Based on results of mark-recapture and radio-tracking studies (Pahlke et al. 1996, Pahlke 1997 *In press*), the survey expansion factors for the Unuk, Chickamin, Blossom and Keta rivers were revised in 1995 to 4× the summed tributary counts. The new expansion factor produced an estimated escapement of 4,668 large chinook salmon to the Unuk River in 1996, an increase of 51% from 1995. Escapements of chinook salmon to the Unuk River have been above the escapement goal during 3 of the last 7 years (Figure 7). The average escapement over the base period of

Table 8.–Peak escapement counts of chinook salmon to index areas of the Unuk River, 1960–1996.

Year[a]	Cripple Creek	Genes Lake Creek	Eulachon Creek	Clear Creek	Lake Creek	Kerr Creek	Total
1960	–[b]	–	250 (A)	–	–	–	250
1961	3 (F)	200 (F)	270 (F)	65 (F)	–	53 (F)	591
1962	–	150 (A)	145 (A)	100 (A)	30 (A)	–	425
1963	100 (A)	750 (A)	150 (A)	25 (A)	–	–	1,025
1964	–	–	25 (A)	–	–	–	25
1965	–	–	–	–	–	–	0
1966	–	–	–	–	–	–	0
1967	–	–	60 (H)	–	–	–	60
1968	–	–	75 (H)	–	–	–	75
1969	–	–	150 (H)	–	–	–	150
1970	–	–	–	–	–	–	0
1971	–	–	30 (A)	–	–	–	30
1972	95 (A)	35 (A)	450 (A)	90 (A)	55 (A)	–	725
1973	–	–	64 (H)	–	–	–	64
1974	–	–	68 (H)	–	–	–	68
1975	–	–	17 (H)	–	–	–	17
1976	–[c]	–	3 (A)	–	–	–	3
1977	529[c] (F)	339 (F)	57 (H)	34 (H)		15 (H)	974
1978	394[c] (F)	374 (F)	218 (H)	85 (H)	20 (H)	15 (H)	1,106
1979	363 (F)	101 (F)	48 (H)	14 (H)	30 (H)	20 (H)	576
1980	748 (F)	122 (F)	95 (H)	28 (H)	5 (H)	18 (H)	1,016
1981	324 (F)	112 (F)	196 (H)	54 (H)	20 (H)	25 (H)	731
1982	538 (F)	329 (F)	384 (H)	24 (H)	48 (H)	28 (H)	1,351
1983	459 (F)	338 (F)	288 (H)	24 (H)	12 (H)	4 (H)	1,125
1984	644 (F)	647 (F)	350 (H)	113 (H)	32 (H)	51 (H)	1,837
1985	284 (F)	553 (F)	275 (H)	37 (H)	22 (H)	13 (H)	1,184
1986	532 (F)	838 (F)	486 (H)	183 (F)	25 (H)	62 (H)	2,126
1987	860 (F)	398 (F)	520 (H)	107 (H)	37 (H)	51 (H)	1,973
1988	1,068 (F)	154 (F)	146 (F)	292 (H)	60 (H)	26 (H)	1,746
1989	351 (F)	302 (F)	298 (H)	128 (H)	27 (F)	43 (H)	1,149
1990	86 (F)	284 (F)	81 (H)	103 (F)	26 (F)	11 (H)	591
1991	358 (W/F)	123 (F)	43 (H)	96 (F)	23 (F)	12 (H)	655 [d]
1992	327 (W/F)	360 (F)	57 (F)	69 (F)	31 (H)	30 (H)	874 [e]
1993	448 N(F)	330 N(F)	132 E(F)	137 N(F)	8 N(F)	13 P(H)	1,068 [f]
1994	161 P(F)	300 N(F)	52 N(H)	128 E(F)	18 N(F)	52 N(F)	711 [g]
1995	211 N(F)	347 N(F)	74 N(H)	66 E(H)	35 E(H)	39 N(H)	772
86–95 Average	440	344 N(F)	189	131	29	34	1,167
1996	417 N(F)	400 N(F)	79 N(F)	148 E(F)	25 E(H)	98 E(F)	1,167

[a] Counts prior to 1975 may not be comparable due to differences in survey dates and counting methods.

[b] — = no survey conducted or data not comparable; (F) = escapement survey conducted by walking river; (A) = escapement survey conducted from fixed-wing aircraft; (H) = escapement survey conducted from helicopter; (W/F) = weir and foot count; N = survey conditions normal; E = excellent; P = poor.

[c] Not including 35 fish for egg take in 1976; 132 in 1977; 85 in 1978.

[d] Total does not include 108 from Boundary Creek, Cripple Creek weir count reduced by /0.625 to be comparable with foot surveys.

[e] Total does not include 123 from Boundary Creek, Cripple Creek weir count reduced by /0.625 to be comparable with foot surveys.

[f] Total does not include 143 from Boundary Creek.

[g] Total does not include 42 fish from Boundary Creek.

Table 9.–Distribution of spawning chinook salmon among index areas of the Unuk River for years when all index areas were surveyed.

Year	Cripple Creek	%	Genes Lake Creek	%	Eulachon Creek	%	Clear Creek	%	Lake Creek	%	Kerr Creek	%	Total
1978	394	36	374	34	218	20	85	8	20	2	15	1	1,106
1979	363	63	101	18	48	8	14	2	30	5	20	3	576
1980	748	74	122	12	95	9	28	3	5	0	18	2	1,016
1981	324	44	112	15	196	27	54	7	20	3	25	3	731
1982	538	40	329	24	384	28	24	2	48	4	28	2	1,351
1983	459	41	338	30	288	26	24	2	12	1	4	0	1,125
1984	644	35	647	35	350	19	113	6	32	2	51	3	1,837
1985	284	24	553	47	275	23	37	3	22	2	13	1	1,184
1986	532	25	838	39	486	23	183	9	25	1	62	3	2,126
1987	860	44	398	20	520	26	107	5	37	2	51	3	1,973
1988	1,068	61	154	9	146	8	292	17	60	3	26	1	1,746
1989	351	31	302	26	298	26	128	11	27	2	43	4	1,149
1990	86	15	284	48	81	14	103	17	26	4	11	2	591
1991	358	55	123	19	43	7	96	15	23	4	12	2	655
1992	327	37	360	41	57	7	69	8	31	4	30	3	874
1993	448	42	330	31	132	12	137	13	8	0	13	1	1,068
1994	161	23	300	42	52	7	128	18	18	3	52	7	711
1995	211	27	347	45	74	10	66	9	35	5	39	5	772
Avg.	453	40	334	28	208	18	94	8	27	2	29	2	1,144
1996	417	36	400	34	79	7	148	13	25	2	98	8	1,167

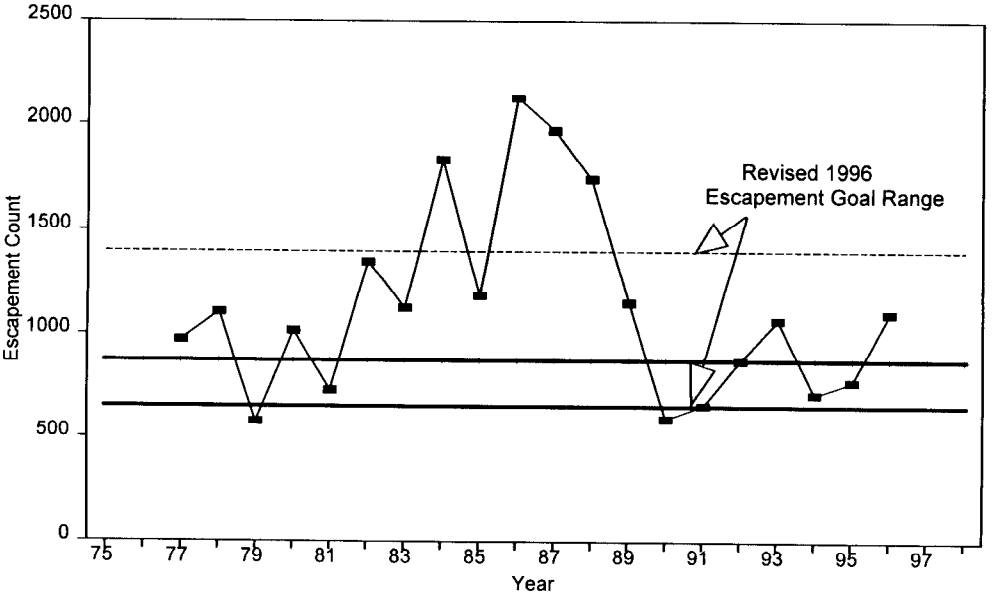

Figure 7.–Counts of large chinook salmon in index areas of the Unuk River, 1975–1996. No rebuilding line is shown because the base period (1975-1980) average escapement was above the escapement goal (revised 1996). Crosshatch line is goal, dashed and solid lines are upper and lower ranges for goal.

1976–1980 is above the revised escapement goal for the Unuk River; therefore, no base-to-goal rebuilding line is needed.

Chickamin River

In 1996, 422 large chinook salmon were counted in index areas on eight tributaries of the Chickamin River, compared to 356 in 1995 (Table 10). Counts in 1996 were below average in all but two Chickamin River tributaries (Table 11). The 1996 count was 20% below the survey escapement goal (revised in 1996 to 525, range 450 to 900 fish) (McPherson and Carlile 1997.).

The summed counts for 1996 were expanded by a survey expansion factor of 4× to produce a total escapement estimate of 1,688 fish to the watershed. The 1996 total escapement was similar to 1992–1995, but lower than average 1981–1985 and 1986–1990 escapements. The 1996 escapement was again below both the escapement goal and the rebuilding schedule. Total escapements had been above the linear rebuilding schedule from 1980 to 1991 and below the schedule since 1992 (Figure 8).

Blossom River

Two hundred twenty (220) large chinook salmon were counted in index areas of the Blossom River in 1996, similar to the 217 fish counted in 1995 (Table 12). The 1996 count was approximately 27% below the revised survey goal of 300 (range 250 to 500)(McPherson and Carlile 1997). Counts had exceeded the goal from 1982–1989, but since 1991, they have generally fallen below the linear rebuilding schedule (Figure 9). The summed counts for 1996 were expanded by a survey expansion factor of 2.5× to produce a total escapement estimate of 550 fish.

Keta River

In 1996, 297 chinook salmon were counted in the Keta River, up from 175 counted in 1995 (Table 12) and near the 1996 revised goal of 300 (range 250 to 500) large fish (McPherson and Carlile 1997). Prior to 1990, counts of chinook salmon in the Keta River increased steadily since implementation of the 1980 rebuilding program, and had exceeded the rebuilding schedule every year since 1981 (Figure 10). The summed counts for 1996 were expanded by a survey expansion factor of 2.5× to produce a total escapement estimate of 743 fish.

Marten and Wilson Rivers

Counts of chinook salmon in the Marten and Wilson Rivers are not included in the regional index program, and no official escapement goals have been set for these systems. However, regular counts have been made in the Marten River since 1982 because of its proximity to other surveyed systems.

In 1996, 62 large chinook salmon were counted during aerial surveys of the Marten River, down from the count of 171 in 1995. In 1988, the U.S. Forest Service modified a barrier on Dicks Creek, a major tributary of the Marten River, with the objective of opening access to new spawning areas. Since then, aerial surveys have documented chinook salmon above the barrier site indicating some success.

Twenty-three (23) large chinook salmon were counted in the Wilson River in 1996, down from 58 in 1995. The Grant and Klahini Rivers, small chinook systems in Behm Canal which have been surveyed sporadically, were not surveyed in 1996.

King Salmon River

Two helicopter surveys and a foot survey were conducted on King Salmon River in 1996. The peak count during the helicopter surveys was 131 large chinook salmon and 192 were counted during the foot survey. Survey counts, (after subtracting removals for hatchery egg takes) have been slightly below the goal of 167 fish since 1983, with the exceptions of 1993 and 1996 (Table 13; Figure 11).

Peak count of 192 was expanded by the 1996 revised survey expansion factor of 1.5× to produce a total escapement estimate of 288 large fish to the system.

Table 10.–Counts of chinook salmon in index areas of the Chickamin River, 1960–1996.

Year[a]	South Fork Creek	Barrier Creek	Butler Creek	Leduc Creek	Indian Creek	Humpy Creek	King Creek	Clear Falls Creek	Total[c]
1960	–[b]	–	–	–	–	3 (A)	–	–	3
1961	–	36 (A)	77 (A)	42 (A)	5 (A)	120 (A)	48 (A)	–	328
1962	400 (A)	35 (A)	–	–	–	150 (A)	–	–	585
1963	350 (A)	115 (A)	–	–	–	3 (A)	200 (A)	–	668
1964	–	–	–	–	–	–	–	–	–
1965	–	–	–	–	–	–	75 (A)	–	75
1966	–	–	–	–	–	50 (F)	–	–	50
1967	–	–	–	–	–	-	45 (H)	–	45
1968	–	–	–	–	–	30 (H)	20 (H)	–	50
1969	–	–	–	–	–	10 (H)	45 (H)	–	55
1970	–	–	–	–	–	–	–	–	–
1971	–	–	–	–	–	–	–	–	–
1972	350 (A)	25 (A)	–	85 (A)	–	65 (A)	510 (A)	–	1,035
1973	–	–	–	–	–	14 (A)	65 (A)	–	79
1974	144 (H)	–	–	–	–	–	11 (H)	–	155
1975	141 (H)	9 (H)	66 (H)	6 (H)	90 (H)	7 (H)	30 (H)	–	370
1976	46 (H)	10 (H)	15 (H)	12 (H)	9 (H)	–	–	–	157
1977	52 (H)	66 (H)	30 (H)	26 (H)	53 (H)	0 (H)	–	–	363
1978	21 (H)	94 (H)	4 (H)	42 (H)	20 (H)	–	–	–	308
1979	63 (H)	17 (H)	29 (H)	0 (H)	31 (H)	–	–	–	239
1980	56 (H)	62 (H)	104 (H)	17 (H)	22 (H)	–	–	–	445
1981	51 (H)	105 (H)	51 (H)	25 (H)	12 (H)	4 (F)	105 (F)	31 (H)	384
1982	84 (H)	149 (H)	37 (H)	36 (H)	30 (F)	37 (F)	165 (F)	33 (H)	571
1983	28 (H)	138 (H)	91 (H)	30 (H)	47 (H)	–	212 (F)	30 (H)	599
1984	185 (H)	171 (H)	124 (H)	15 (H)	103 (H)	88 (F)	388 (F)	28 (H)	1,102
1985	163 (H)	129 (H)	92 (H)	8 (H)	125 (H)	50 (H)	377 (H)	12 (H)	956
1986	562 (H)	168 (H)	203 (H)	20 (H)	120 (H)	–	564 (H)	40 (H)	1,745
1987	261 (H)	76 (H)	120 (H)	19 (H)	115 (H)	26 (H)	310 (H)	48 (H)	975
1988	280 (H/F)	82 (H/F)	159 (H)	25 (H/F)	32 (H)	19 (H/F)	164 (H)	25 (H/F)	786
1989	226 (H/F)	90 (H)	137 (H)	57 (H)	84 (H)	22 (H/F)	224 (H)	94 (H)	934
1990	135 (F)	107 (H)	27 (H)	20 (H)	24 (H)	35 (H)	163 (H)	53 (H)	564
1991	125 (H)	18 (H)	49 (H)	14 (H)	38 (H)	13 (H)	185 (H)	45 (H)	487
1992	87 (H)	4 (H)	68 (H)	4 (H)	20 (H)	8 (H)	131 (H)	24 (H)	346
1993	67 N(H)	46 E(H)	68 N(H)	11 N(H)	29 N(H)	13 N(H)	80 N(H)	75 N(H)	389
1994	31 N(H)	29 E(H)	64 E(H)	18 E(H)	16 N(H)	44 N(H)	129 E(H)	57 E(H)	388
1995	87 E(H)	12 E(F)	59 E(F)	60 E(H)	36 N(F)	13 N(F)	62 N(H)	27 E(H)	356
1986-1995 Avg.	186	63	95	25	51	21	201	49	691
1996	72 N(H)	13 N(F)	74 E(H)	23 E(H)	48 N(F)	30 N(F)	106 E(F)	56 E(H)	422

[a] Escapement counts conducted prior to 1975 may not be comparable due to differences in survey dates and counting methods.

[b] — = no survey conducted or data not comparable; (A) = escapement surveyed by fixed-wing aircraft; (F) = escapement surveyed by walking stream; (H) = escapement surveyed by helicopter; (H/F) = escapement surveyed by combination of walking and helicopter; N = survey conditions normal; E = excellent.

[c] Totals for 1975–1980, 1983 and 1986 expanded for unsurveyed index areas by 1981–1992 average % observed to those indices.

Table 11.–Distribution of spawning chinook salmon into index areas of the Chickamin River for years when all index areas were surveyed.

Year	South Fork Creek	%	Barrier Creek	%	Butler Creek	%	Leduc Creek	%	Indian Creek	%	Humpy Creek	%	King Creek	%	Clear Falls Creek	%	Total
1981	51	13	105	27	51	13	25	7	12	3	4	1	105	27	31	8	384
1982	84	15	149	26	37	6	36	6	30	5	37	6	165	29	33	6	571
1984	185	17	171	16	124	11	15	1	103	9	88	8	388	35	28	3	1,102
1985	136	14	156	16	93	10	8	0	125	13	50	5	377	39	12	1	957
1987	261	27	76	8	120	12	19	2	115	12	26	3	310	32	48	5	975
1988	280	36	82	10	159	20	25	3	32	4	19	2	164	21	25	3	786
1989	226	24	90	10	137	15	57	6	84	9	22	2	224	24	94	10	934
1990	135	24	107	19	27	5	20	4	24	4	35	6	163	29	53	9	564
1991	125	26	18	4	49	10	14	3	38	8	13	3	185	38	45	9	487
1992	87	25	4	1	68	20	4	1	20	6	8	2	131	38	24	7	346
1993	67	17	46	12	68	17	11	3	29	7	13	3	80	21	75	19	389
1994	31	8	29	7	64	16	18	5	16	4	44	11	129	33	57	15	388
1995	87	24	12	3	59	17	60	17	36	10	13	4	62	17	27	8	356
Avg.	156	22	90	13	90	13	24	3	55	8	25	4	217	31	42	6	699
1996	72	17	13	3	74	18	23	5	48	11	30	7	106	25	56	13	422

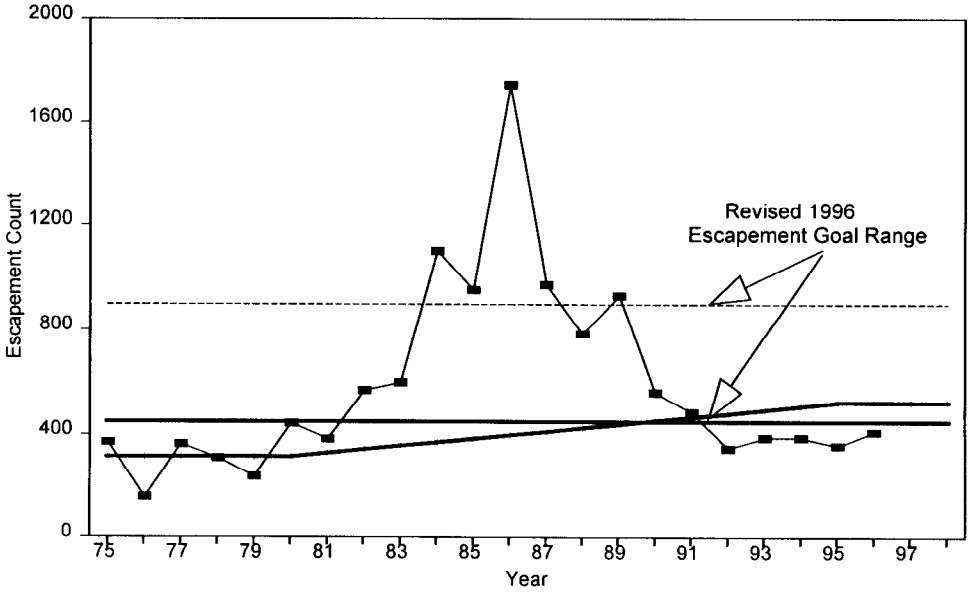

Figure 8.–Counts of chinook salmon in index areas of the Chickamin River, 1975–1996. Base-to-goal line indicates linear rebuilding schedule, starting in 1981 at average escapement level during the base period (1975–1980) and ending at index escapement goal of 525 large chinook salmon in 1995 (final year of the three-cycle rebuilding program). Crosshatch line is base period to goal, dashed and solid lines are upper and lower ranges for goal.

Table 12.–Counts of chinook salmon for selected rivers in Behm Canal, 1948–1996.

Year[a]	Keta River	Blossom River	Wilson River	Marten River	Grant River	Klahini River	Total
1948	500 (F)[b]	–	–	–	–	–	500
1949	–	–	–	–	–	–	–
1950	210 (F)	–	–	–	–	–	210
1951	120 (F)	–	–	–	–	–	120
1952	462 (F)	–	–	–	–	–	462
1953	156 (F)	–	–	–	–	–	156
1954	300 (A)	–	–	–	–	–	300
1955	1,000 (A)	–	–	–	–	–	1,000
1956	1,500 (A)	–	–	–	–	–	1,500
1957	500 (A)	–	–	–	–	–	500
1958	–	–	–	–	–	–	–
1959	–	–	–	–	–	–	–
1960	–	–	–	–	–	–	–
1961	44 (F)	68 (F)	–	22 (F)	40 (A)	-	174
1962	–	–	–	–	6 (A)	100 (A)	106
1963	–	450 (A)	375 (A)	–	15 (A)	–	840
1964	–	–	–	–	–	–	–
1965	–	–	50 (A)	43 (H)	–	–	93
1966	75 (A)	200 (A)	60 (A)	10 (A)	100 (A)	3 (A)	448
1967	86 (H)	–	8 (H)	7 (H)	15 (H)	–	116
1968	–	–	–	–	4 (H)	–	4
1969	200 (A)	–	10 (A)	10 (A)	69 (H)	3 (H)	292
1970	–	100 (H)	–	–	–	–	100
1971	–		–	–	–	–	–
1972	255 (A)	225 (A)	275 (A)	–	25 (A)	150 (A)	930
1973	–	–	30 (A)	–	38 (A)	7 (H)	75
1974	25 (H)	166 (H)	–	–	–	–	191
1975	203 (H)	146 (H)	7 (H)	15 (H)	–	–	371
1976	84 (H)	68 (H)	–	–	–	–	152
1977	230 (H)	112 (H)	–	–	–	–	342
1978	392 (H)	143 (H)	–	2 (A)	–	–	537
1979	426 (H)	54 (H)	36 (H)	–	–	–	516
1980	192 (H)	89 (H)	–	–	–	–	281
1981	329 (H)	159 (H)	76 (F)	–	25 (H)	42 (F)	631
1982	754 (H)	345 (H)	300 (B)	75 (F)	33 (F)	79 (F)	1,586
1983	822 (H)	589 (H)	178 (B)	138 (B)	8 (A)	10 (H)	1,745
1984	610 (H)	508 (H)	133 (F)	12 (B)	124 (F)	54 (F)	1,441
1985	624 (H)	709 (H)	420 (H)	69 (F)	55 (F)	20 (F)	1,897
1986	690 (H)	1,278 (H)	–	–	–	–	1,968
1987	768 (H)	1,349 (H)	–	270 (H)	33 (A)		2,420
1988	575 (H)	384 (H)	–	543 (H)	–	40 (H)	1,542
1989	1,155 (H)	344 (H)	–	133 (H)	–	–	1,632
1990	606 (H)	257 (H)	–	283 (H)	–	–	1,146
1991	272 (H)	239 (H)	–	135 (H)	–	–	646
1992	217 (H)	150 (H)	109 (H)	76 (H)	25 (H)	19 (H)	596
1993	362 E(H)	303 N(H)	63 P(H)	229 E(H)	–	–	957
1994	306 E(H)	161 N(H)	–	178 E(H)	–	–	645
1995	175 E(H)	217 N(H)	58 N(H)	171 E(H)	–	–	621
1986–95 Avg.	513	468	77	224	29	30	1,217
1996	297 N(H)	220 E(H)	23 P(H)	62 N(H)	–	–	602

[a] Escapement counts prior to 1975 may not be comparable due to differences in survey dates or methods.

[b] (F) = escapement surveyed by walking stream; — = no survey conducted or data not comparable; (A) = escapement surveyed from fixed-wing aircraft; (H) = escapement surveyed from helicopter; (B) = escapement surveyed from boat; N = survey conditions normal; E = excellent.

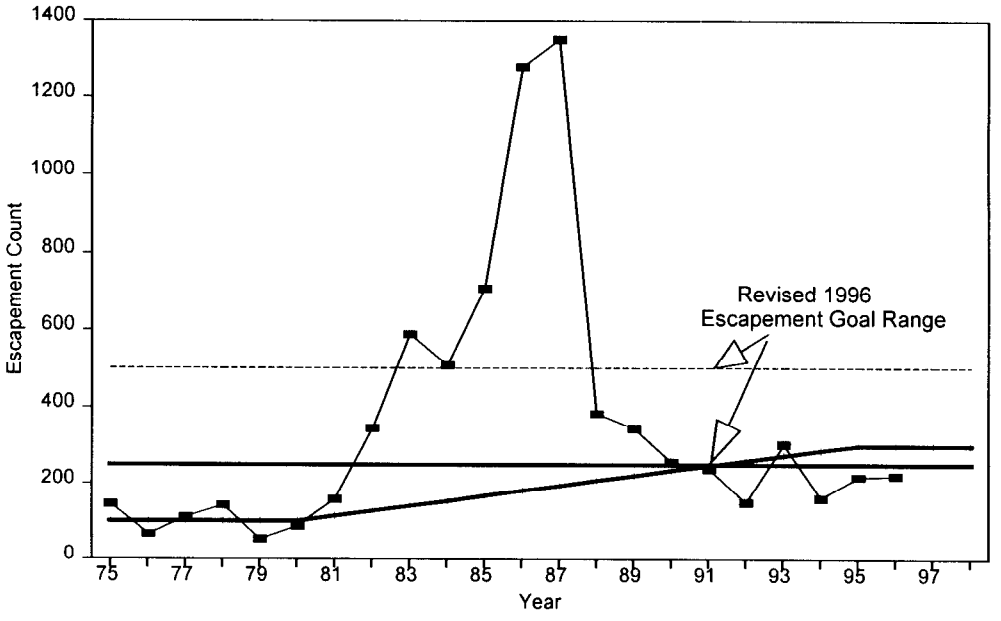

Figure 9.–Counts of chinook salmon into the Blossom River, 1975–1996. Base-to-goal line shows linear rebuilding schedule, starting in 1981 at average escapement level during base period (1975–1980) and ending at escapement goal of 300 large chinook salmon in 1995 (final year of the three-cycle rebuilding program). Crosshatch line is base period to goal, dashed and solid lines are upper and lower ranges for goal.

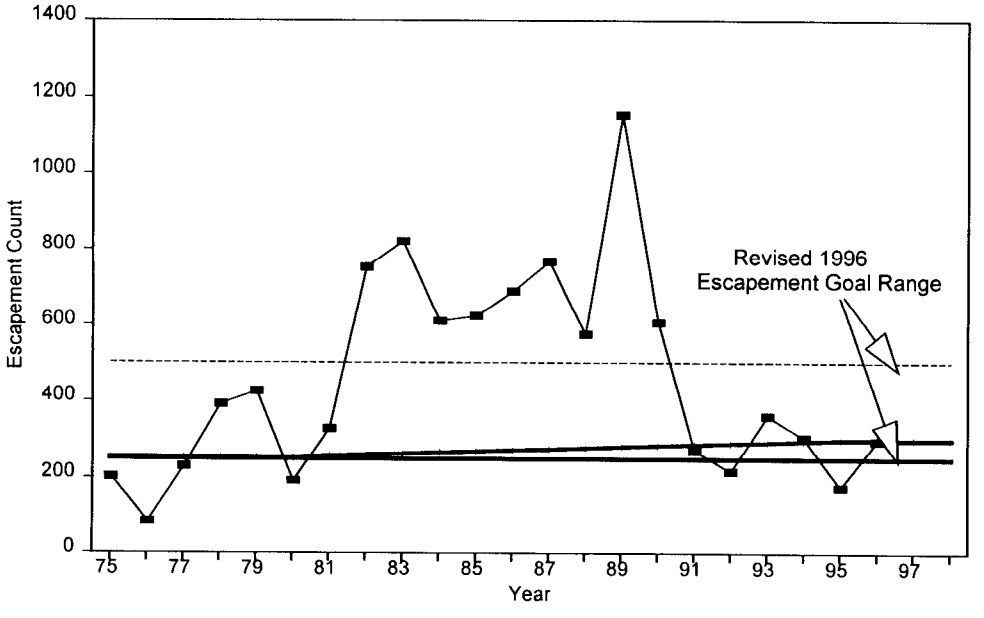

Figure 10.–Counts of chinook salmon to the Keta River, 1975–1996. Base-to-goal line shows linear rebuilding schedule, starting in 1981 at average escapement level during base period (1975–1980) and ending at escapement goal of 300 large chinook salmon in 1995 (final year of the three-cycle rebuilding program). Crosshatch line is base to goal, dashed and solid lines are upper and lower ranges for goal.

Table 13.–Peak escapement counts and weir counts of spawning chinook salmon in the King Salmon River, 1957–1996

Year	Survey count: Below weir A	Survey count: Above weir B	Survey as percent of weir count B/(D-C)	Total egg take (adults) C	Total weir count (adults) D	Total weir count (jacks)[b] E	Adults below weir (foot ct) F	Total inriver (adults) D+F	Total natural spawning D+F-C
1957	–[a]	200 (F)	–	–	–	–	–	–	200
1960	–	20 (F)	–	–	–	–	–	–	20
1961	–	117 (F)	–	–	–	–	–	–	117
1971	–	94 (F)	–	–	–	–	–	–	94
1972	–	90 (F)	–	–	–	–	–	–	90
1973	–	211 (F)	–	–	–	–	–	–	211
1974	–	104 (F)	–	–	–	–	–	–	104
1975	–	42 (H)	–	–	–	–	–	–	42
1976	–	65 (H)	–	–	–	–	–	–	65
1977	–	134 (H)	–	–	–	–	–	–	134
1978	–	57 (H)	–	–	–	–	–	–	57
1979	–	88 (H)	–	17	–	–	–	–	71
1980	–	70 (H)	–	–	–	–	–	–	70
1981	–	101 (H)	–	11	–	–	–	101	90
1982	–	259 (H)	–	30	–	–	–	259	229
1983	25	183 (H)	85%	37	252	20	30	282	245[c]
1984	14	184 (H)	71%	46	299	82	12	311	265[c]
1985	12	105 (H)	64%	29	194	45	10	204	175[c]
1986	9	190 (H)	80%	26	264	72	17	281	255[c]
1987	19	128 (H)	73%	31	207	62	20	227	196[c]
1988	5	94 (H)	50%[d]	35	231	54	12	243	208[c]
1989	34	133 (H)	63%	38[e]	249	71	29	278	240[c]
1990	34	98 (H)	57%	29	190	32	8	198	179[c]
1991	6	91 (H)	72%	20	146	89	8	154	134[c]
1992	–	58 (H)	59%[f]	18	47	16	70	117	99[c]
1993	–	175 E(H)	----------no weir or egg take----------						175
1994	–	140 N(F)	----------no weir or egg take----------						140
1995	–	97 P(H)	----------no weir or egg take----------						97
1983–92 Avg.	17	126	67%	31	209	56	22	231	188
1996	–	192 E(F)	----------no weir or egg take----------						192

[a] — = no survey conducted or data not comparable; (F) = escapement surveyed by walking stream; (H) = escapement surveyed from helicopter; N = survey conditions normal; E = excellent; P = poor.

[b] Minimum count as jacks could pass through weir.

[c] Natural spawning (adults) = (total inriver - egg take; 1983-1992).

[d] Four females and two males were held but not spawned for egg take; % = 94/(231-37-6) = 50%.

[e] Includes holding mortality of 4 males and 6 females for egg take.

[f] Peak survey was after weir was removed 58/99 = 59%.

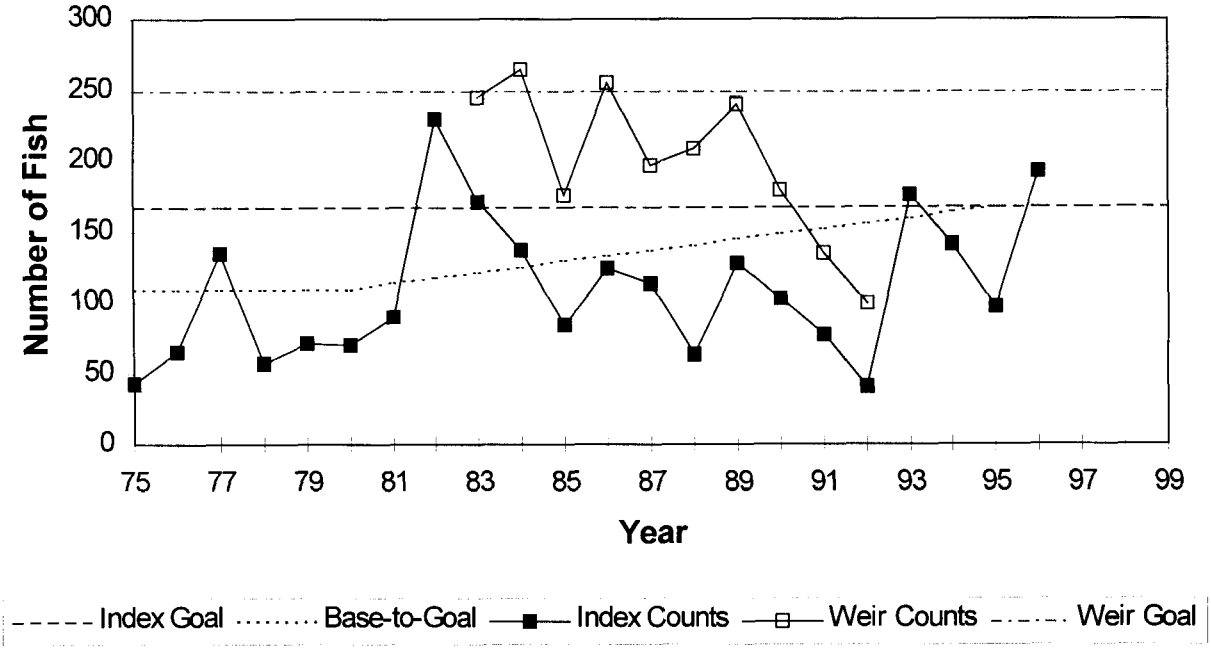

Figure 11.–Counts of chinook salmon at a weir and in the index area of the King Salmon River, 1975-1996. Base-to-goal line shows linear rebuilding schedule, starting in 1981 at average escapement level during base period (1975–1980) and ending at index escapement goal of 167 large chinook salmon in 1995 (final year of the three-cycle rebuilding program. Fish removed for broodstock are subtracted from counts.

SITUK RIVER

Escapement of large chinook salmon to the Situk River in 1996 was 1,913 fish, a 56% decrease over the 1995 escapement of 4,355 fish, but still above the escapement goal of 600 large spawners (Table 14). On the basis of spawner-recruit analysis, ADF&G in 1991 revised the management escapement goal from 2,000 chinook salmon in the Situk River to 600 large fish, with a range of 450–750 (ADF&G 1991). This revised goal has been adopted by the PSC and the Alaska Board of Fisheries as part of a management plan for the Situk River. Escapements have exceeded the revised escapement goal each year since 1984 (Figure 12). The proportion of the recreational harvest that is caught above the weir varies from year to year and is estimated by the local management biologists and from the statewide harvest survey (Howe et al. *in press*). The escapement counts from the base period all exceed the revised escapement goal, indicating the Situk chinook salmon stock was not depressed and never needed rebuilding.

CHILKAT RIVER

The 1996 escapement to the Chilkat River was estimated by mark-recapture experiment to be 4,920 large chinook salmon (Ericksen *In press.*). Since Johnson et al. (1992) demonstrated that expansion factors used on the Chilkat River system were inaccurate, the management escapement goal of 2,000 large fish needs to be assessed. A new index method and management escapement goal will be developed when a sufficient number of abundance estimates have been conducted (Johnson et al. 1993, Johnson 1994, Ericksen 1996).

Table 14.–Harvest, escapement, and minimum total run of Situk River chinook salmon, 1975–1996.

	Commercial chinook harvests			Recreational harvests		Escapement			Total run size[a]	
	Yakutat	Situk River				Large	Small		Large	All
Year	Bay	Commercial	Subsistence	Large	Small	chinook	chinook	Total	only	chinook
1976	69	1,002	41	200	–	1,365	576	1,941	2,318	3,185
1977	53	833	24	244	–	1,732	148	1,880	2,595	2,981
1978	108	382	50	210	–	776	327	1,103	1,298	1,745
1979	51	1,028	25	282	–	1,266	534	1,800	2,308	3,135
1980	164	969	57	233	120	905	220	1,125	1,879	2,504
1981	151	858	62	49	81	702	105	807	1,270	1,857
1982	419	248	27	35	28	434	177	611	672	949
1983	371	349	50	11	41	592	257	849	866	1,300
1984	145	512	89	137	14	1,726	475	2,201	2,427	2,953
1985	240	484	156	224	287	1,521	461	1,982	2,233	3,133
1986	211	202	99	0	37	2,067	505	2,572	2,290	2,910
1987	329	891	24	73	322	1,265	534	1,799	2,215	3,109
1988	196	299	90	161	27	837	185	1,022	1,337	1,599
1989	297	1	496	0	0	653	1,218	1,871	1,073	2,368
1990	304	0[b]	516	0	0	676	687 [c]	1,363	969	1,879
1991	392	786	220	65	31	878	707 [c]	1,585	1,679	2,687
1992	147	1,504	341	131	50	1,579	352 [c]	1,931	3,103	3,957
1993	148	790	202	101	151	899	3,099	3,998	1,717	5,242
1994	258	2,656	367	160	407	1,263	2,983	4,246	2,974	7,836
1995	264	8,106	594	1,007	679	4,355	3,293	7,648	13,335	18,034
1986–95 Avg.	255	1,524	295	170	170	1,447	1,356	2,804	3,069	4,962
1996	185	3,717	564	1,183 [d]	892	1,913[e]	1,433	3,346	6,633	9,702

[a] Total run = chinook escapement + Situk commercial, sport, and subsistence harvests. An unknown portion of the Yakutat Bay catch is Situk fish. Large chinook are 3 to 5-ocean-age and small are 1 and 2-ocean age. Commercial and subsistance catches include some small chinook (Scott McPherson, unpublished report).

[b] Non-retention regulation in effect for commercial fisheries in 1989 and 1990; estimated personal use harvest of 400 large chinook in 1990, 415 in 1990, and 109 in 1991.

[c] Small chinook escapement includes 1 and 2-ocean jacks from 1990 to 1996, prior to 1990 1-ocean fish were not counted.

[d] Preliminary estimate of recreational harvest.

[e] Escapement from . Scott McPherson, ADF&G Sport Fish, Douglas, personal communication.

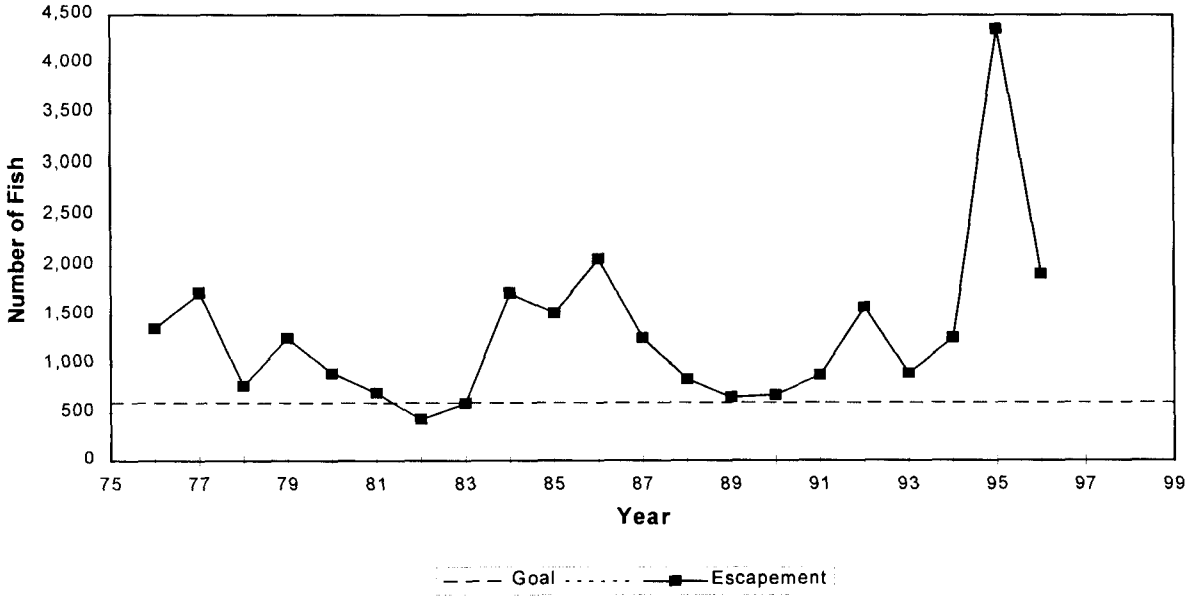

Figure 12.–Counts of chinook salmon at the Situk River weir, 1975–1996

DISCUSSION

The utility of the index method as a measure of escapement is based on the assumption that the number of fish counted in an index area is a constant proportion of the escapement in the index area or watershed. Therefore, a change in the escapement causes a proportional change in the index count. Implicit in this method are sources of error that fall into two categories:

Factors that are constant sources of error: (1) interference with the ability to count fish; conditions such as heavily shaded areas or topography that prevents close approach with a helicopter, presence of other species that could be confused with chinook salmon, overhanging brush, or deep or occluded water (accounted for by a survey expansion factor); and (2) estimates of distribution among tributaries (accounted for by tributary expansion factors).

Factors that are not constants: (1) changes in migratory timing will produce a reduced count; (2) a very large number of spawners may cause reduced counts relative to the number of fish in the index area; (3) changes in the distribution of spawners among the tributaries of a watershed among years; and (4) inclement weather, turbidity events, or changes in pilot and/or observer experience.

Consequently, even though estimates of total escapement may be incorrect, multi-year trends in escapement are correct.

To judge rebuilding progress, the Pacific Salmon Commission focuses on whether trends in counts are above or below a linear rebuilding schedule (see Figures 2-11). This method will correctly reflect the rate of rebuilding, provided the ratio of the count to escapement and the effect of "constant factors" do not change among years and that "non-constant factors" are infrequent events.

Expanded counts are needed when comparing indices among watersheds or for estimating exploitation rates and spawner/recruit relationships. Though survey and tributary expansion factors have been endorsed by the Pacific Salmon Commission (PSC) since 1981, the original expansion factors were developed on the basis of judgment rather than on empirical data, and error associated with these expansions could be large. Johnson et al. (1992) showed that expansion factors for the

Chilkat River greatly underestimated escapement to that watershed. ADF&G recognized the need to develop better expansions throughout the region, and has estimated distribution and escapement for chinook salmon in the Unuk (Pahlke 1995), Chickamin (Pahlke 1996, in prep) and Taku rivers (Pahlke and Bernard 1996, McPherson et al. in press). Projects are continuing on those rivers, along with the Stikine and Alsek rivers. On the basis of information collected on the Unuk and Chickamin rivers, expansion factors for the four Behm Canal systems were revised in 1996. The expansion factor for the King Salmon River was based on 10 years of weir counts compared with aerial surveys, and the expansion factor for Andrew Creek was based on 4 years of paired weir and survey counts. Changing the escapement goals, however, requires a formal review by ADF&G, and the Chinook Technical Committee of the PSC, as was done for the Situk River in 1991 and the Behm Canal systems in 1994. The Canadian Department of Fisheries and Oceans and the Transboundary Technical Committees are included in any review of Taku, Stikine or Alsek River goals. The expansion factor for the Taku River was revised in 1996 after 4 years of mark-recapture data indicated that the sum of the six tributaries counted was consistently close to 25% of the total escapement to the drainage (McPherson et al. 1997).

Expansion factors and escapement goals will continue to be revised as we learn more about the actual relationships between index counts and total escapement. Any change in survey methods must take into account the comparability of historical data with new data. Year-to-year consistency and repeatability of index counts may be more important than their absolute accuracy to agencies that compare escapement estimates between years.

Currently, only one of the 22 minor producers in the region and six of nine medium producing watersheds are included in the index survey program. Expansion of counts from these streams to represent the escapement of all streams in minor and medium producing categories most likely produces inaccurate estimates of total escapement. However, because escapement to small and medium systems are a small proportion to the total 1996 region escapement, errors in those estimates would have little effect on estimates of regional escapement. In 1995 and again in 1996, surveys were flown on the Harding River and Aaron Creek to determine the feasibility of adding these medium and small systems to the program. The remaining systems are too remote, and funds are not currently available for these surveys. It may be more reasonable to expand the small systems by some proportion of the nearest surveyed systems, rather than using only the King Salmon River.

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APPENDIX A

Appendix A1.–Management escapement goals and survey and tributary expansion factors for Southeast Alaska and transboundary rivers. Category escapement goal equals sum of the survey escapement goal times survey and tributary expansion factors times the category expansion factor.

River system	Index tributaries surveyed	Survey escapement goal [a]	Lower Range of Escapement Goal	Upper Range Escapement Goal	System escapement goal	Category expansion factor	Category escapement goal
Major Production Systems (Total = 3)							
Alsek	Klukshu	4,700 (W)[b]	c	c	7,344[f]		
Taku	6 tributaries	13,210 (A)[b]	c	c	52,840[f]		
Stikine	Little Tahltan	5,300 (W)[b]	c	c	21,200[f]		
Major category subtotal		23,210			81,384	3/3	81,384
Medium Production Systems (Total = 9)							
Situk	All	600 (W)[g]	600[i]	750[i]	600[g]		
Chilkat	All	2,000 (M)	c	c	2,000		
Andrew Cr.	All	470 (A)	c	c	750 [h]		
Unuk	All	875 (A)[g]	650[i]	1,400[i]	3,500		
Chickamin	All	525 (A)[g]	450[i]	900[i]	2,100		
Blossom	All	300 (A)[g]	250[i]	500[i]	750		
Keta	All	300 (A)[g]	250[i]	500[i]	750		
Medium category subtotal		5,070			10,450	9/7	13,436
Minor Production Systems (Total = 22)							
King Salmon	All	167 (F/H)			250		
Minor category subtotal		167			250	22/1	5,500
All systems total		28,447			92,084		100,319

[a] (W) = weir count; (A) = aerial survey peak escapement estimate; (M) = mark/recapture estimate. Survey escapement goal = number of fish actually counted on survey, or through weir.

[b] Index goals jointly agreed between U.S. and Canada and presently used by Chinook Technical Committee (CTC) of Pacific Salmon Commission (PSC), but which have not been scientifically reviewed.

[c] Under review.

[d] Taku and King Salmon rivers expansion factors revised in 1996.

[f] Expanded estimates from index goals which have not been scientifically reviewed or agreed to by U.S. and Canada and are not used by CTC of PSC.

[g] Escapement goals which have been scientifically analyzed through spawner-recruit analysis and are used by the CTC of PSC.

[h] Expanded estimates which have not been scientifically reviewed, but are presently used by CTC and ADF&G.

[i] Biological escapement goal ranges used by ADF&G management.

Appendix A2.–Estimated total escapements of chinook salmon to escapement indicator systems and to Southeast Alaska and transboundary (T) rivers, 1975–1996. Index escapements are expanded for survey counting rates and unsurveyed tributaries, using 1996 revised Taku and King Salmon river expansions and escapement goals.

Year	MAJOR SYSTEMS				MEDIUM SYSTEMS										MINOR SYSTEMS			TOTAL
	Alsek (T)	Taku (T)	Stikine (T)	Major Subt.	Situk	Chilkat	Andrew	Unuk (T)	Chick-amin(T)	Blos-som	Keta	Behm Subt.	Medium Unsurv.	Medium Subt.	King Salm.	Minor Unsurv.	Minor Subt.	ALL SYSTEMS
1975		8,356	5,800	14,156			520		1,481	365	508	2,353	1,437	4,310	62	1,302	1,364	19,830
1976	1,672	18,904	3,300	23,876	1,365		404		627	170	210	1,007	1,388	4,164	96	2,016	2,112	30,152
1977	4,363	22,684	6,600	33,647	1,732		456	3,896	1,450	280	575	6,201	4,195	12,584	199	4,179	4,378	50,609
1978	4,050	13,220	5,200	22,470	776		388	4,424	1,234	358	980	6,995	4,080	12,239	84	1,764	1,848	36,557
1979	6,101	16,624	9,328	32,053	1,266		327	2,304	954	135	1,065	4,458	3,026	9,077	113	2,373	2,486	43,616
1980	3,770	30,176	17,096	51,042	905		282	4,064	1,779	223	480	6,545	3,866	11,598	104	2,184	2,288	64,928
Average	3,991	18,327	7,887	29,541	1,209		396	3,672	1,254	255	636	4,593	2,998	8,995	110	2,303	2,413	40,949
1981	2,837	39,144	26,672	68,653	702		536	2,924	1,536	398	823	5,680	3,459	10,377	139	2,919	3,058	82,088
1982	3,078	19,252	22,640	44,970	434		672	5,404	2,284	863	1,885	10,436	5,771	17,312	354	7,434	7,788	70,070
1983	3,352	8,248	4,752	16,352	592		366	4,500	2,398	1,473	2,055	10,425	5,692	17,075	245	5,145	5,390	38,817
1984	2,038	15,636	10,352	28,026	1,726		389	7,348	4,408	1,270	1,525	14,551	8,333	24,999	265	5,565	5,830	58,855
1985	1,853	28,832	12,456	43,141	1,521		640	4,736	3,824	1,773	1,560	11,893	7,027	21,080	175	3,675	3,850	68,071
Average	2,632	22,222	15,374	40,228	995		521	4,982	2,890	1,155	1,570	10,597	6,056	18,169	236	4,948	5,183	63,580
1986	3,966	30,080	11,564	45,610	2,067		1,414	8,504	6,980	3,195	1,725	20,404	11,942	35,827	255	5,355	5,610	87,047
1987	3,598	22,972	19,132	45,702	1,265		1,576	7,892	3,900	3,373	1,920	17,085	9,963	29,889	196	4,116	4,312	79,903
1988	2,891	34,504	29,168	66,563	837		1,128	6,984	3,144	960	1,438	12,526	7,245	21,736	208	4,368	4,576	92,875
1989	3,399	37,920	18,860	60,179	653		1,060	4,596	3,736	860	2,888	12,080	6,896	20,689	240	5,040	5,280	86,148
1990	2,722	48,996	17,568	69,286	676		1,328	2,364	2,256	643	1,515	6,778	4,391	13,172	179	3,759	3,938	86,396
Average	3,315	34,894	19,258	57,468	1,100		1,301	6,068	4,003	1,806	1,897	13,774	8,087	24,262	216	4,528	4,743	86,474
1991	3,165	40,612	18,024	61,801	878	5,897	800	2,620	1,948	598	680	5,846	3,834	17,255	134	2,814	2,948	82,004
1992	1,950	44,232	26,508	72,690	1,579	5,284	1,556	3,496	1,384	375	543	5,798	4,062	18,279	99	2,079	2,178	93,147
1993	4,811	52,816	45,796	103,423	899	4,472	2,120	4,272	1,556	758	905	7,491	4,280	19,262	259	5,439	5,698	128,383
1994	5,532	39,652	25,800	70,984	1,263	6,795	1,144	2,844	1,552	403	765	5,564	4,219	18,984	207	4,347	4,554	94,522
1995	8,579	35,028	13,036	56,643	4,355	3,790	686	3,088	1,424	543	438	5,492	4,092	18,415	144	3,024	3,168	78,226
Average	4,807	42,468	25,833	73,108	1,795	5,248	1,261	3,264	1,573	535	666	6,038	4,098	18,439	169	3,541	3,709	95,256
1996	**4,401**	**79,108**	**19,360**	**102,869**	**1,913**	**4,920**	**670**	**4,668**	**1,688**	**550**	**743**	**7,649**	**4,329**	**19,481**	**288**	**6,048**	**6,336**	**128,686**
1996 CHANGE FROM 1995																		
Number	(4,178)	44,080	6,324	46,226	(2,442)	1,130	(16)	1,580	264	8	306	2,157	237	1,066	144	3,024	3,168	50,460
Percent	-49%	126%	49%	82%	- 56%	30%	-2%	51%	19%	1%	70%	39%	6%	6%	100%	100%	100%	65%
Goals[a]	7,344	52,840	21,200	81,384	600	2,000	750	3,500	2,100	750	750	7,100	2,986	13,436	250	5,250	5,500	100,320
Average percent of goal																		
75-80	54%	35%	37%	36%	201%		53%	105%	60%	34%	85%	65%	100%	67%	44%	44%	44%	41%
81-85	36%	42%	73%	49%	166%		69%	142%	138%	154%	209%	149%	203%	135%	94%	94%	94%	63%
86-90	45%	66%	91%	71%	183%		173%	173%	191%	241%	253%	194%	271%	181%	86%	86%	86%	86%
91-95	65%	80%	122%	90%	299%	262%	168%	93%	75%	71%	89%	85%	137%	137%	67%	67%	67%	95%

[a] See footnotes regarding escapement goals in Appendix A1.

Appendix A3.–Detailed 1996 Southeast Alaska chinook salmon escapement surveys as entered into Commercial Fisheries Division Integrated Fisheries Database (IFDB).

7/28/97	10:24												IFDB-SES-01 Page 1
Stream Number	Stream Name	Date	Survey Type	Dis	Species	Mouth	Tidal	Live	Dead	Total Count	Obs.	Coded	Comment	Other Comments
101-30-030	Keta River	19-Aug	H		Chinook			121		121	KAP	22		23 up top
		27-Aug	H		Chinook			292	5	297	KAP	21		40 up top
101-30-060	Marten River	19-Aug	H		Chinook			62		62	KAP	22		29 in Dicks CR.
101-45-007	Herring Cove	23-Jul	A		Chinook	50				50	PSD	22 32	43	
101-45-078	Carroll Creek	16-Jul	A		Chinook	150				150	PSD	22 32	43	
101-45-081	Falls Creek	9-Jul	A		Chinook						SBW	22 32	42	
		5-Aug	A		Chinook	500				500	PSD	21 33	43	
101-47-025	Ketchikan Creek	25-Sep	F		Chinook				3	3	SBW	22 32	43	
101-55-020	Wilson River	27-Aug	H		Chinook			23		23	KAP	23		poor, too many pinks
101-55-040	Blossom River	19-Aug	H		Chinook			49		49	KAP	23		poor visibility
		27-Aug	H		Chinook			215	5	220	KAP	21		
101-71-004	Chickamin River	1-Oct	H		Chinook			2		2	GMF	23 32		just below barrier creek, NO surv South fork
101-71-04A	Barrier Creek	1-Aug	F		Chinook			7		7	DLM	22		
		7-Aug	H		Chinook			6		6	KAP	22		
		10-Aug	F		Chinook			13		13	KAP	22		
		14-Aug	H		Chinook			7		7	KAP	21		
101-71-04B	Butler Creek	4-Aug	F		Chinook			57		57	DLM	22		
		6-Aug	H		Chinook			48		48	KAP	22		
		14-Aug	H		Chinook			74		74	KAP	21		
101-71-04C	Clear Creek	27-Jul	F		Chinook			56		56	DLM	22		
		6-Aug	H		Chinook			40		40	KAP	22		

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Stream Number	Stream Name	Date	Survey Type	Dis	Species	Mouth	Tidal	Live	Dead	Total Count	Obs.	Coded	Comment	Other Comments
		14-Aug	H		Chinook			56		56	KAP	21		
101-71-04H	Humpy Creek	25-Aug	F		Chinook			30		30	DLM	99		sampled 18
101-71-04I	Indian Creek	26-Jul	F		Chinook			39		39	DLM	21		
		31-Jul	F		Chinook			46	2	48	DLD	22		
		7-Aug	H		Chinook			15		15	KAP	22		
101-71-04K	King Creek	14-Aug	H		Chinook			31		31	KAP	23		too many pinks
		27-Aug	F		Chinook			106		106	DLM	21		
101-71-04L	Leduc River	6-Aug	H		Chinook			17		17	KAP	22		
		14-Aug	H		Chinook			23		23	KAP	21		
101-71-04S	South Fork Chickamin	1-Aug	F		Chinook			32		32	DLM	22		
		7-Aug	H		Chinook			72		72	KAP	22		50 below rapids
		14-Aug	H		Chinook			61		61	KAP	21		
101-75-015	Eulachon River	14-Aug	H		Chinook			70		70	KAP	22		
		18-Aug	F		Chinook			79		79	DLD	22		
101-75-03B	Boundary Cr Unik R	6-Aug	F		Chinook						DLM	23		poor visibility
101-75-30C	Clear Creek-Unuk R	7-Aug	H		Chinook			95		95	KAP	22		
		13-Aug	F		Chinook			148		148	DLD	21		
101-75-30G	Genes Lake CreekUnuk	7-Aug	H		Chinook			400		400	KAP	22		schooled in lake
101-75-30K	Kerr Creek-Unuk R	7-Aug	H		Chinook			73		73	KAP	21		low end clear
		11-Aug	F		Chinook			98		98	DLD	22		
		14-Aug	H		Chinook			27		27	KAP	22		
101-75-30L	Lake Creek-Unuk R	7-Aug	H		Chinook			9		9	KAP	22		3 at falls
		14-Aug	H		Chinook			25		25	KAP	21		4 at falls
101-75-30Q	Cripple Ck-Unuk R	7-Aug	F		Chinook			417		417	DLM	22		
101-80-070	Hatchery Ck-Yes Bay	26-Aug	F		Chinook			7		7	TPZ	21	31	5>20 lbs, 2<10 lbs, 1 ad clip

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Stream Number	Stream Name	Date	Survey Type	Dis	Species	Mouth	Tidal	Live	Dead	Total Count	Obs.	Coded	Comment	Other Comments
106-44-031	Crystal Creek	10-Jun	A		Chinook		25			25	BLL	23 32	42	5 ABV RAPIDS, 20+ BLW BIG ROCK
		26-Jun	A		Chinook		20			20	WRB	23 32	42	NOT MUCH SHOWING @ RAPIDS
		6-Jul	A		Chinook		200	80		280	BLL	22 32	42	DARK BOTTOM HARD TO COUNT
		11-Jul	A		Chinook	100	650		1	751	WRB	23 31	43	3 HT & 2 SF @ M, 5 SF @ RAPIDS
		14-Jul	A		Chinook		600	5		605	WRB	23 32	43	300 BLW RAPIDS 200 ABV 50 IN SLOU
		26-Jul	A		Chinook			400	700	1,100	BLL	22 33	43	51 100 @ M OF CRYSTAL CR.
		29-Jul	A		Chinook		100	300	400	800	WRB	22 33	41	+400 IN HATCHERY PONDS
107-40-024	Aaron Creek	13-Aug	H		Chinook			15		15	KAP	22		at top end
107-40-049	Harding River	6-Aug	A		Chinook			15		15	WRB	22 33	43	TO MANY DOGS FOR ACCURATE COUNT
		13-Aug	H		Chinook			15		15	KAP	23		poor visibility
		5-Sep	A		Chinook			75		75	WRB	22 32	41	
107-40-052	Bradfield River N Fk	6-Aug	A		Chinook			78		78	WRB	22 33	43	MOSTLY 7 MI UP RT SIDE MAIN CHANN
107-40-053	Bradfield River E Fk	6-Aug	A		Chinook			48		48	WRB	23 33	43	
107-40-055	Eagle R Bradfield	6-Aug	A		Chinook			7		7	WRB	21 33	42	TO MANY PINK & CHUM FOR GOOD COUN
107-45-078	Earl West Creek	2-Jul	A		Chinook	5				5	WRB	22 31	42	
		24-Jul	A		Chinook			100		100	WRB	22 32	43	4K KING HARV IN 1996
108-40-020	Andrews Creek	19-Jul	A		Chinook						WRB	21 32	42	
		8-Aug	F		Chinook			64	2	66	RGZ	22 32		INCLUDES 3 JACKS
		13-Aug	H		Chinook			335		335	KAP	22		107 in N. arm
		13-Aug	F		Chinook			298	2	300	RGZ	22 32		INCL. 39 IN N. ARM, 9 JACKS
		19-Aug	F		Chinook			332	2	334	RGZ	22 32		INC. 18 LIVE & 2 DEAD JACKS
		28-Aug	A		Chinook			21	16	37	RLT	23 32		MOST FISH IN LOWER SECTION

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Stream Number	Stream Name	Date	Survey Type	Dis	Species	Mouth	Tidal	Live	Dead	Total Count	Obs.	Coded	Comment	Other Comments
		18-Aug	A		Chinook			21		21	WRB	22	32	
108-41-010	North Arm Creek	19-Jul	A		Chinook						WRB	21	32 42	
		8-Aug	F		Chinook			16	2	18	RLT	22	31	
		13-Aug	F		Chinook			35		35	RGZ	22	32	INC. 1 JACK
		20-Aug	F		Chinook			3		3	RGZ	22	32	
108-80-100	Tahltan River	31-Jul	H		Chinook			772		772	KAP	22		only 108 below Beatty
108-80-115	Beatty Ck Tahltan R	31-Jul	H		Chinook			217		217	KAP	22		8 goats
		6-Aug	H		Chinook			218		218	KAP	22		
108-80-120	Little Talhtan River	31-Jul	H		Chinook			1,694	90	1,784	KAP	21	33	
		6-Aug	H		Chinook			1,536	384	1,920	KAP	22		
		15-Aug	W		Chinook			4,840		4,840	DFO	99		WEIR TOTAL
109-63-005	Joyce Ck Malmesbury	14-Aug	F		Chinook	1				1	BLL	11	22 32 41 52	
111-17-010	King Salmon River	23-Jul	H		Chinook			82		82	KAP	22		
		26-Jul	H		Chinook			131		131	KAP	21		
		26-Jul	F		Chinook			192		192	KAP	21		18 2'JACKS, 3 1'JACKS
111-32-220	Nakina River	30-Jul	H		Chinook			1,440		1,440	KAP	22	32 51	IA1
		30-Jul	H		Chinook			3,118		3,118	KAP	22	32	IA 1,2
		30-Jul	H		Chinook			930		930	KAP	22	32	IA 4
		30-Jul	H		Chinook			5,488		5,488	KAP	22	32	Total
		3-Aug	H		Chinook			1,810	100	1,910	KAP	21	51	IA 1
		3-Aug	H		Chinook			750	40	790	KAP	21	52	IA 2
		3-Aug	H		Chinook			3,550	200	3,750	KAP	21		IA 3
		3-Aug	H		Chinook			1,160	110	1,270	KAP	21		IA 4
		3-Aug	H		Chinook			7,370	350	7,720	KAP	21		Peak Total
111-32-240	Kowatua Creek	13-Aug	H		Chinook			1,456	5	1,461	KAP	21		20 above weir
		21-Aug	H		Chinook			1,540	80	1,620	KAP	22		
111-32-255	Tatsamenie River	21-Aug	H		Chinook			1,756		1,756	KAP	22		245 outlet big lake, lots sockeye
		26-Aug	H		Chinook			1,911	100	2,011	KAP	22		200 outlet big lake

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Stream Number	Stream Name	Date	Survey Type	Dis	Species	Mouth	Tidal	Live	Dead	Total Count	Obs.	Coded	Comment	Other Comments
111-32-270	Nahlin River	22-Jul	H		Chinook			2,300		2,300	KAP	22 33	51	IA 1
		22-Jul	H		Chinook			406		406	KAP	22 33	52	IA 2
		22-Jul	H		Chinook			5,051		5,051	KAP	22 33		Peak Total
		30-Jul	H		Chinook			1,076		1,076	KAP	21 33	51	IA 1
		30-Jul	H		Chinook			610	70	680	KAP	21 33	52	IA 2
		30-Jul	H		Chinook			3,293	366	3,659	KAP	21 33		IA 3
		30-Jul	H		Chinook			4,979	436	5,415	KAP	21 33		total
111-32-275	Tseta Creek	30-Jul	H		Chinook			1,201		1,201	KAP	22		
		3-Aug	H		Chinook			855	50	905	KAP	22		
111-32-280	Dudidontu River	30-Jul	H		Chinook			1,810		1,810	KAP	22		750 above lake
		3-Aug	H		Chinook			1,404	156	1,560	KAP	22		
111-50-069	Fish Creek-Douglas I	26-Jul	F		Chinook	18				18	WSL	11 33		present in pond but no count, clo to mouth
		5-Sep	F		Chinook		1	10	30	41	WSL	99		
112-17-030	Fishery Creek	27-Aug	F		Chinook		1			1	LED	41		
182-30-020	Kluckshu River (CAN)	2-Aug	H		Chinook			788		788	KAP	22		
		30-Aug	W		Chinook			3,599		3,599	DFO	99		WEIR TOTAL
182-30-043	Takhanni River (CAN)	2-Aug	H		Chinook			190	40	230	KAP	22		
182-30-045	Goat Creek	2-Aug	H		Chinook			12		12	KAP	22		
182-30-051	Blanchard Lake (CAN)	2-Aug	H		Chinook			101	30	131	KAP	22		28 above bridge
182-40-010	Akwe River	18-Jun	A		Chinook			10		10	GFW	22 33	42	
		18-Jun	A		Chinook			10		10	GFW	22 33	43	
182-70-010	Situk RIver	8-Jul	B		Chinook			756		756	MST	21 33	42	Situk Lake to weir, 46 above brid rest below

Restrictions selected: Year = 1996 and species code (410)

Appendix B1

ORIGINS OF ESCAPEMENT GOALS FOR CHINOOK SALMON IN SOUTHEAST ALASKA AND TRANSBOUNDARY RIVERS

INTRODUCTION

A rebuilding program for chinook salmon stocks in Southeast Alaska (SEAK) was initiated by the Alaska Department of Fish and Game (ADF&G) in 1981 to help rebuild depressed chinook stocks in Southeast Alaska and transboundary river systems by 1995 (ADF&G, 1981). As part of this rebuilding program, interim escapement goals were established for 9 systems: the Alsek, Taku, Stikine, Situk, King Salmon, Unuk, Chickamin, Keta and Blossom/Wilson Rivers. Although the aim was to have escapement goals that provided the optimal level of harvest, little data was available to produce such estimates. As a result, the interim escapement goals were set as the highest observed escapement count prior to 1981.

Except for the Situk River, total escapement had not been estimated in any of the other rivers in 1981. The only available data were survey counts, which count a fraction of total escapement and which were standardized in most systems beginning in 1975. In an attempt to convert index counts to estimates of total escapement, survey counts in index tributaries were multiplied by expansion factors to account for the proportion of spawners thought to be observed in surveys (survey expansion factor SEF) and the proportion of the entire system represented by the index tributary(s) (tributary expansion factor TEF). The expansion factors were based largely upon professional judgment of the biologists familiar with the watersheds; these expansion factors had little or no quantifiable basis. However, it is necessary to have estimates of total escapement for modeling various parameters such as total production, harvest rate, spawner-recruit relationships, etc., and hence, the need for expansions of index data.

The ADF&G chinook rebuilding program was incorporated into the coastwide rebuilding program adopted by the Pacific Salmon Commission (PSC) by 1985 with the signing of the U.S./Canada Salmon Treaty. Agencies for each Party (Alaska, Canada and the southern U.S.) provided their best estimates of escapement goals for key rivers in each region, and the Chinook Technical Committee (CTC) uses these escapement indicator stocks to judge stock status and recommend management for chinook stocks from SEAK to Oregon (CTC 1986). By 1985, ADF&G had added Andrew Creek and the Chilkat River to the suite of key indicator stocks of wild chinook salmon in SEAK, bringing the total to 11 indicator (index) stocks.

This appendix details the history of the derivation of the interim escapement goals for the 11 SEAK chinook indicator stocks and some preliminary and final scientific analyses which have been used to evaluate or revise the 1981 interim escapement goals. When the Salmon Treaty was signed in 1985, it was anticipated

that stock assessment programs would be improved to the point that by the mid to late 1990s, enough data would be available with which to revise escapement goals based upon solid scientific analysis. To date, escapement goals have been evaluated for five SEAK indicator stocks (Situk, Unuk, Chickamin, Blossom and Keta Rivers) using spawner recruit analysis and the other six are under review at the present time.

ALSEK RIVER

Escapement of chinook salmon to the Alsek River has been enumerated since 1976, using standardized methods, at a weir near the mouth of the Klukshu River. The Klukshu is one of many tributaries of the Tatshenshini River, the principal tributary of the Alsek which is accessible to anadromous stocks. The Klukshu weir counts represent an index for the Alsek drainage; an unknown fraction of the total escapement for the Alsek drainage is represented by the Klukshu weir escapement. Annual spawning escapements for the Klukshu River are determined by subtracting the aboriginal harvest above the weir from the weir count.

The Alsek River is one of three rivers (along with the Taku and Stikine) which is jointly managed as a transboundary river by the U.S. (ADF&G) and Canada (DFO), through the Transboundary Technical Committee (TRTC) of the PSC. Since 1981, ADF&G and DFO have made several attempts to define an interim escapement for the entire Alsek drainage or an interim index goal for the escapement through Klukshu weir.

Until 1991, the two countries had separate goals, which were for the entire Alsek drainage. The escapement goal established by ADF&G in 1981, of 5,000 chinook salmon for the entire Alsek River was mistakenly derived from 3,200 fish as the highest Klukshu count between 1976 and 1980 and a factor of 1.56 (1/0.64) was used to expand the number to represent the entire system. The highest count actually recorded between 1976 and 1980 when the goals were originally set was 4,403 chinook, which occurred in 1979. The Canadian goal of 12,500 chinook for the entire Alsek was derived from Canada's original Klukshu goal of 5,000 chinook and an expansion factor of 2.5. Through 1990, the CTC use separate goals of 5,000 (U.S.) and 12,500 (Canadian) for the entire Alsek in annual reports (CTC 1991).

The TRTC 1984 postseason report lists the U.S. escapement goal for the Alsek as 7,200 chinook salmon. The origin of this goal is uncertain however, in a 1981 staff report, ADF&G used historical harvest to estimate a similar goal. During the period 1920-1930, an average annual catch of 14,300 chinook were taken in the Alsek River terminal gill net fishery. Assuming an average production rate of 3 to 4 adults produced per spawner, staff estimated an escapement of 4,770 to 7,150 would have been required to produce this level of catch.

A spawner-recruit analysis completed in 1991 by the TRTC indicated an optimum escapement of only 716 large fish to the Klukshu River. A multiplicative model was constructed using return data through 1990. Known harvests of Alsek fish were included in this model.

In October 1991, the U.S. proposed a index goal of 4,400 fish, as the escapement goal for the Klukshu River, while Canada considered this level to still represent a depressed stock level and set 5,000 as their goal. The TRTC agreed to average the two numbers and recommended that an escapement of 4,700 chinook be used as the escapement goal for the Klukshu River until a better goal is developed. Since 1991, the CTC has used an single index goal of 4,700 spawners in the Klukshu River in annual assessments (CTC 1992).

In Sept. 1995 John H. Clark, assisted by Pete Etherton of CDFO and McPherson of ADF&G, put together a draft analysis of the Klukshu spawner-recruit relationship and that analysis indicated point estimates ranging from 914 to 967 spawners as the MSY goal. This analysis was reviewed in separate internal reviews by ADF&G and CDFO. This analysis was accepted with slight revision by ADF&G internal review (suggested goal should be in range of somewhere between 1,000 to 2,000 spawners. The recommendation of 914 to 967 point estimate was rejected by internal CDFO review in the Pacific Stock Assessment Review Committee (PSARC). The entire analysis is currently being redone to incorporate recommendations from ADF&G, CDFO, TRTC and members of the CTC and is scheduled to be reviewed by fall of 1997 (McPherson, Etherton and Clark *in prep*).

TAKU RIVER

The escapement goal established by ADF&G in 1981 for Taku River chinook salmon was based on the largest escapement ever observed on the Nakina River, historically the tributary with the highest production. A count of 9,000 fish was recorded there in 1952 and has never been surpassed . The Nakina was assumed to contribute 40% of the total Taku system and 75% of the escapement was assumed to be observed thus, the total minimum escapement goal was (9,000/ .40)/.75 = 30,000 fish. The Nahlin River was added to the indicator stock prior to 1985. The peak Nahlin escapement of 2,500 in 1958 was combined with the Nakina to give a goal of 11,500 fish. The two tributaries were assumed to contribute 60% of the Taku River chinook salmon thus the goal was reduced to 25,550 large chinook (11,500/0.60/0.75 = 25,555).

Aerial surveys of escapement have been conducted fairly regularly on six index tributaries on the Taku River since 1965, which include only counts of large chinook ≥ 660 mm MEF. Prior to 1991, the U.S. expanded counts from only the Nakina and Nahlin River index areas to estimate the escapement to the entire Taku River, while Canada expanded counts from all six index tributaries. The Canadian goal was 15,000 to the six index areas, which was then expanded by two to a total goal of 30,000 large spawners.

In October 1991, it was agreed by both Parties to use counts from all six tributaries when they are available. Not all tributaries are equally easy to survey and poor conditions could limit surveys in some years. In such cases counts of the surveyed tributaries will be expanded to represent the six tributaries based on the historical average proportions (TRTC 1991). A joint escapement goal for the combined counts of the six index tributaries was developed by summing each individual tributary's highest count between 1965 and

1981, resulting in a survey goal of 13,200 large chinook salmon. This goal incorporates no expansion factors and refers to chinook actually counted in the surveyed tributaries by helicopter.

The spawner-recruit database for Taku River is the most complete of the transboundary rivers, with relatively standardized escapement data back to the late 1960s. At present the available data is being analyzed to estimate an escapement goal of large chinook for the entire drainage and is scheduled to be completed by spring of 1998. A full stock assessment program is in place on the Taku annually to estimate total escapement by mark-recapture techniques and coded-wire tagging of smolt to estimate marine harvest (McPherson et al. 1996, *in press*).

STIKINE RIVER

Chinook escapement to the Little Tahltan River, a tributary in the Stikine River system, has been enumerated using aerial survey counts since 1975 and weir counts since 1985. The Little Tahltan River counts form an index for the Stikine River, similar to that of Klukshu weir on the Alsek. In 1981, ADF&G established a goal of 2,100 fish observed in the Little Tahltan based on the peak escapement of 2,137 observed in 1980. The Little Tahltan is assumed to contribute 25% of the Stikine River total escapement. Total Stikine River escapement goal was then (2,100/.25)/.625 = 13,440 or 13,700 depending on rounding. A Little Tahltan River weir goal of 3,360 was obtained by expanding the aerial survey escapement goal (rounded off from 2,137 to 2,100) to be comparable to weir counts currently made (i.e. 2,100/0.625 or 3,360). Canada previously developed an escapement goal of 6,250 fish for Little Tahltan River based on previous levels of escapements and taking into consideration that those levels were considered depressed.

At the October 1991 meeting of the TRTC, both Parties, based on data available from 1985 to 1990 when both aerial surveys and weir counts were available, agreed to use a factor of two to increase aerial counts to weir counts (TRTC 1991). The U.S. goal for the Little Tahltan weir was 4,300 chinook salmon and the Canadian goal was 6,250 and 4,300, respectively, and a joint escapement goal of 5,300 fish counted through Little Tahltan weir was established.

Both Parties have used for several years an expansion factor of four to raise the weir count to a total Stikine system escapement estimate. This factor is not based on any scientific study and the TRTC recommended using just the Little Tahltan River escapements to assess rebuilding. Beginning in 1996, a mark-recapture project is being operated annually to estimate total escapement to the Stikine drainage and to estimate the fraction spawning above Little Tahltan weir (Pahlke and Etherton *in prep*).

UNUK RIVER

The Unuk River survey escapement goal of 1,800 large spawners was established in 1981 by using the maximum observed escapement between 1961 and 1980 which was mistakenly calculated as 1,765 fish in

1978. The 1978 escapement count was corrected to 1,106 fish in 1985 when it was found that some of the surveys had been entered twice into the ADF&G escapement survey database. This was still the highest survey count prior to the rebuilding period, but the survey goal remained at 1,800 fish until 1994. ADF&G and the CTC estimated the total escapement goal by expanding the index goal by 1/0.625 to a total of 2,880, which was used by the CTC through the 1992 annual report (CTC 1993).

A revised survey goal of 875 large spawners based on spawner-recruit analysis was approved by CF director in May 1994, based on draft paper by McPherson and Carlile in 1994, which was also accepted by CTC in Oct. 1994 for inclusion in the 1993 CTC report (CTC 1994). The final report recommended a biological escapement goal range of 650 to 1,400 large spawners in the survey counts (McPherson and Carlile 1997). Mark-recapture studies on the Unuk and Chickamin River in 1994-1996 indicate that between 15% and 25% of the total escapement of large spawners are counted in the helicopter/foot surveys on these two systems (Pahlke et al. 1996; Pahlke 1996, in prep). These data indicate that the total escapement goal range of large spawners for the Unuk River is in the neighborhood of 2,600 to 5,600 or 4,300 to 9,300, which is larger than the pre-1984 expanded estimate. Mark-recapture experiments will continue for a few years on this system, which will improve the accuracy of estimating the expansion factor.

CHICKAMIN RIVER

The Chickamin River survey goal of 900 large spawners was established in 1981 based on the 1972 escapement count of 860 fish. The 860 total was the sum of only two (South Fork and King Creeks) of the 8 tributaries presently surveyed in the index system. Somewhere between 1981 and 1987 the counts from Barrier, Leduc, and Humpy Creeks were included in the 1972 escapement which then totaled 1,035 fish. The survey goal remained 900 large spawners until 1994. ADF&G and the CTC estimated the total escapement goal by expanding the index goal by 1/0.625 to a total of 1,440 which was used by the CTC through the 1992 annual report (CTC 1993).

A revised survey goal of 525 large spawners based on spawner-recruit analysis was approved by CF director in May 1994, based on draft paper by McPherson and Carlile in 1994, which was also accepted by CTC in Oct. 1994 for inclusion in the 1993 CTC report (CTC 1994). The final report recommended a biological escapement goal range of 450 to 900 large spawners in the survey counts (McPherson and Carlile 1997). Mark-recapture studies on the Unuk and Chickamin River in 1994-1996 indicate that between 15% and 25% of the total escapement of large spawners are counted in the helicopter/foot surveys on these two systems (Pahlke et al. 1996; Pahlke 1996, in prep). These data indicate that the total escapement goal range of large spawners for the Chickamin River is in the neighborhood of 2,600 to 5,600 or 4,300 to 9,300, which is larger than the pre-1984 expanded estimate.

KETA RIVER

The Keta River survey goal of 500 large spawners was established in 1981 based on counts of 500 fish in 1948 and 462 fish in 1952. Counts of 1,000 and 1,500 in 1955 and 1956 were discounted as being probably

mixed counts of chum and chinook salmon. The goal remained at 500 until 1994 and ADF&G and the CTC, until 1984, used an estimate of 800 total large spawners by expanding the index goal by 1/0.625.

A revised goal of 300 spawners based on spawner-recruit analysis was approved by CF director in May 1994, based on draft paper by McPherson and Carlile in 1994, which was also accepted by CTC in Oct. 1994 for inclusion in the 1993 CTC report (CTC 1994). The final report recommended a biological escapement goal range of 250 to 500 large spawners in the survey counts (McPherson and Carlile 1997). ADF&G estimates that the total escapement goal range the Keta River is in the neighborhood of 600 to 1,300 large spawners, assuming that 40% of large spawners are counted in index surveys.

BLOSSOM RIVER

The Blossom River escapement goal was originally established in 1981 as a combined goal for the Wilson and Blossom Rivers of 800 fish, based on the 1963 escapement to the two rivers of 825 fish. Prior to 1985, the Wilson River was removed from the index area expansion method, but the goal for the Blossom remained 800 fish. The peak escapement count prior to 1980 for to the Blossom River alone was 450 fish in 1963. Based on the methodology used to establish other Southeast Alaska chinook salmon escapement goals in 1981, the Blossom River goal should have been lowered, but was not until 1994. Regular surveys of the Wilson River were discontinued in 1986 due to budgetary constraints.

A revised goal of 300 spawners based on spawner-recruit analysis was approved by CF director in May 1994, based on draft paper by McPherson and Carlile in 1994, which was also accepted by CTC in Oct. 1994 for inclusion in the 1993 CTC report (CTC 1994). The final report recommended a biological escapement goal range of 250 to 500 large spawners in the survey counts (McPherson and Carlile 1997). ADF&G estimates that the total escapement goal range the Blossom River is in the neighborhood of 600 to 1,300 large spawners, assuming that 40% of large spawners are counted in index surveys.

KING SALMON RIVER

The King Salmon River is the only index stream in the minor system category. The total escapement goal of 200 fish was established in 1981 based on the counts of 200 and 211 in 1957 and 1973. Between 1985 and 1986, the goal was revised upward to 250 fish, for no apparent reason. Revised spawner-recruit analysis is being conducted at this time and is scheduled for review in fall 1997.

SITUK RIVER

The Situk River chinook salmon escapement goal (total escapement) was originally established in 1981 as 5,100 fish, based on the peak weir count in 1947 of 5,077; however, it is not recorded if counts in the 1920s to 1950s included jacks. Based on over 30 years of escapement data and a preliminary spawner/recruit

analysis this goal was judged to be unrealistic and it was immediately reduced to 2,100 fish. A subsequent spawner/recruit analysis by ADF&G in 1988 resulted in a recommendation to lower the goal further to a range of 1,000 to 1,400 large chinook salmon, however the goal was not changed (Seibel 1988). Another more detailed analysis was completed in 1991, which recommend a further reduction to 600 fish, with a range of 450 to 900 large spawners (McPherson, ADF&G, Alaska Board of Fish Staff Report). The goal was not changed until 1991 when the Board of Fisheries approved the Situk River Chinook Salmon Management Plan (ADF&G 1991), and a management range of 600 to 750 large spawners (total escapement) was adopted.

ANDREW CREEK

Andrew Creek was not included in the original group of index systems established in 1981. It was included in the 1985 CTC annual report with goal of 750 total or 470 aerial survey. The goal is apparently based on the total weir counts of 468 and 534 in 1976 and 1977. Total counts through a weir should not be expanded by the aerial survey expansion factor, so to be consistent with methods used in 1981, the goal should be about 500 total or about 300 foot or aerial. However, the goal remains at 750 total and is under review at the present time by ADF&G.

CHILKAT RIVER

The Chilkat River was also not included in the original group established in 1981. It was included in the 1985 CTC annual report with a goal of 225 for the Big Boulder Creek tributary only. The origin of this goal is apparently based on the 1984 escapement of 229 fish. This goal was then expanded by an aerial survey expansion factor of 1/0.80 and a tributary expansion factor of 1/0.14 to arrive at a total goal of 2,000. Sometime Stonehouse Creek was added to the survey index area and the goal was doubled to 450. The tributary expansion factor was modified to 1/0.28 so the total goal remained 2,000. In 1991 Sport Fish Division used radio tags and a mark-recapture project to show 1) that Big Boulder and Stonehouse Creek represented less than 5% of the total escapement, 2) they were a poor indicator of escapement trends and 3) that total escapement was larger than expected (4,300 to 6,300 large spawners from 1991 to 1995)(Johnson et al. 1992, Ericksen 1996). The Chilkat has been dropped from the CTC indicator escapement. stock assessment because we only have total escapement estimates from 1991 to 1996 from mark-recapture projects, which are not comparable to any previous index surveys on the Chilkat River. The present total escapement goal of 2,000 large spawners may be evaluated using harvest rate analysis, since wild stock tagging has provided exploitation rates for several recent years.

Appendix B2.–Computer files used to complete this report.

File Name	Description
TAKUCHT.XLW	Excel workbook with tables and charts with annual counts for each index area.
SUMVER96B.XLS	Appendix table A2, with expanded escapement totals for Southeast Alaska
ESC96.XLS	Table 1. Estimated chinook escapement in 1996.
ESC96.DOC	Text of document.
GOALS.XLS	Appendix Table A1. Expanded goals for Southeast Alaska.