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Review of Salmon Escapement Goals in Upper Cook Inlet, Alaska, 2007

by

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

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Measures (fisheries)

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

Mathematics, statistics

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

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The Division of Sport Fish Fishery Manuscript series was established in 1987 for the publication of technically-oriented results of several years' work undertaken on a project to address common objectives, provide an overview of work undertaken through multiple projects to address specific research or management goal(s), or new and/or highly technical methods. Since 2004, the Division of Commercial Fisheries has also used the Fishery Manuscripts series. Fishery Manuscripts are intended for fishery and other technical professionals. Fishery Manuscripts are available through the Alaska State Library and on the Internet: http://www.sf.adfg.state.ak.us/statewide/divreports/html/intersearch.cfm This publication has undergone editorial and peer review.

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ABSTRACT

In January 2007, a salmon escapement goal review committee, composed of Alaska Department of Fish and Game staff from the Division of Commercial Fisheries and Division of Sport Fish, was formed to review Pacific salmon *Oncorhynchus* spp. escapement goals for the major river systems in Upper Cook Inlet, Alaska. Escapement goals were evaluated for 22 Chinook salmon, 1 chum salmon, 3 coho salmon, and 8 sockeye salmon stocks. The committee did not recommend a change to any existing goals, however, the committee recommended re-instating the sustainable escapement goals (SEG) of 50–700 for Campbell Creek Chinook salmon and 15,000–30,000 for Packers Creek sockeye salmon. In addition, the committee recommended removing the SEG for South Fork Eagle River Chinook salmon and Campbell Creek coho salmon.

Key words: Upper Cook Inlet, escapement goal, biological escapement goal, BEG, sustainable escapement goal, SEG, sockeye salmon, *Oncorhynchus nerka*, Chinook salmon, *O. tshawytscha*, coho salmon, *O. kisutch*, chum salmon, *O. keta*, Alaska Board of Fisheries.

INTRODUCTION

Upper Cook Inlet (UCI), Alaska, supports all five species of Pacific salmon *Oncorhynchus*. The Alaska Department of Fish and Game (ADF&G; department) reviews the escapement goals for UCI salmon stocks on a schedule that corresponds to the Alaska Board of Fisheries (BOF) 3-year cycle for considering area regulatory proposals. This report describes the UCI salmon escapement goals that were reviewed in 2007 and presents information from the subsequent 3 years in the context of these goals. UCI escapement goals were thoroughly reviewed during the previous 2004–2005 BOF cycle (Clark et al. 2007; Hasbrouck and Edmundson 2007). Due to the thoroughness of the previous analyses, this review re-analyzed only those goals with recent (2004–2006) data that substantially changed findings from the 2004 review.

Escapement goals were reviewed based on the Policy for the Management of Sustainable Salmon Fisheries (SSFP; 5 AAC 39.222) and the Policy for Statewide Salmon Escapement Goals (EGP; 5 AAC 39.223). The Alaska Board of Fisheries adopted these policies into regulation during winter 2000–2001 to ensure that the state's salmon stocks are conserved, managed, and developed using the sustained yield principle. Two important terms defined in the SSFP were:

"Biological Escapement Goal" or "(BEG)" means the escapement that provides the greatest potential for maximum sustained yield; BEG will be the primary management objective for the escapement unless an optimal escapement or inriver run goal has been adopted; BEG will be developed from the best available biological information, and should be scientifically defensible on the basis of available biological information; BEG will be determined by the department and will be expressed as a range based on factors such as salmon stock productivity and data uncertainty; the department will seek to maintain evenly distributed salmon escapements within the bounds of a BEG;" and

"Sustainable Escapement Goal" or "(SEG)" means a level of escapement, indicated by an index or an escapement estimate, that is known to provide for sustained yield over a 5 to 10 year period, used in situations where a BEG cannot be estimated due to the absence of a stock specific catch estimate; the SEG is the primary management objective for the escapement, unless an optimal escapement or inriver run goal has been adopted by the board, and will be developed from the best available biological information; the SEG will be determined by the department and will be stated as a range that takes into account data uncertainty; the department will seek to maintain escapements within the bounds of the SEG.

During the 2007 review process, escapement goals for the following stocks were evaluated:

- Sockeye salmon *O. nerka*: Fish and Packers creeks, and Crescent, Kasilof, Kenai, Russian (early and late run), and Yentna rivers;
- Chinook salmon *O. tshawytscha*: Alexander, Campbell, Clear, Crooked, Goose, Lake, Little Willow, Montana, Peters, Prairie, Sheep, and Willow creeks, and Chuitna, Chulitna, Deshka, Eagle River South Fork, Kenai (early and late run), Lewis, Little Susitna, Talachulitna, and Theodore rivers;
- Chum salmon *O. keta*: Clearwater Creek;
- Coho salmon *O. kisutch*: Campbell and Jim creeks, and Little Susitna River.

During the winter of 2006–2007, the department established an escapement goal review committee (hereafter referred to as the committee). The committee consisted of 4 Division of Commercial Fisheries and 7 Division of Sport Fish personnel (Table 1). The committee was formed to recommend the appropriate type of escapement goal (BEG or SEG) and provide an analysis for recommending an escapement goal for each stock.

The committee formally met 16 January, 2007 to review escapement goals and develop recommendations. The committee also communicated by email. All committee recommendations were reviewed by ADF&G regional and headquarters staff prior to being adopted by ADF&G as escapement goals per the SSFP and EGP.

METHODS

Available escapement, catch, and age data for each stock were compiled from research reports, management reports, and unpublished historical databases. Escapement refers to the annual estimated size of the spawning salmon stock. Escapement is affected by a variety of factors including exploitation, predation, diseases, and physical and biological changes in the environment. The committee evaluated the type, quality, and quantity of data for each stock. This evaluation was used to determine the appropriate type of escapement goal as defined in regulation. Generally speaking, an escapement goal for a stock should provide escapement that produces sustainable yields. Escapement goals for salmon have typically been based on spawner-recruit relations (e.g., Beverton and Holt 1957; Ricker 1954), which represent the productivity of the stock and estimated carrying capacity. However, specific methods to determine escapement goals vary in their technical complexity. Thus, escapement goals should be evaluated and revised over time as improved methods of assessment and goal setting are developed, and when new and better information become available. An escapement goal for a stock was defined as a BEG if a sufficiently long time series of escapement, catch, and age estimates were available; the estimates were sufficiently accurate and precise; and the data were considered sufficient to provide a scientifically defensible estimate of MSY (as per rules and methods in Hilborn and Walters 1992; CTC 1999; Quinn and Deriso 1999). A BEG is used when the reference points can be estimated and there is sufficient fishing power and inseason management capability to harvest annual runs to achieve the BEG. An escapement goal for a stock was defined as an SEG if a sufficiently long time series of escapement estimates were available, but there was concern about the spawner-return data (lack of age composition estimates and/or concern with stock-specific catch allocation) or there was a lack of information on stock productivity.

STUDY AREA

The UCI management unit consists of that portion of Cook Inlet north of Anchor Point and is divided into the Central and Northern districts (Figure 1). The Central District is approximately 120 km (75 miles) long, averages 50 km (32 miles) in width, and is further subdivided into 6 subdistricts. The Northern District is 80 km (50 miles) long, averages 32 km (20 miles) in width, and is divided into 2 subdistricts. Commercial salmon fisheries target mainly sockeye salmon with secondary catches of Chinook, coho, chum and pink salmon. Sport fish management is divided into the Northern Kenai Peninsula, Northern Cook Inlet, and the Anchorage management areas. These areas offer diverse personal use and recreational fishing opportunities for all 5 species of Pacific salmon.

ESCAPEMENT AND HARVEST DATA COLLECTION

Estimates or indices of salmon escapement are obtained with a variety of methods such as foot and aerial surveys, capture-recapture experiments, weir counts, and hydroacoustics (sonar). Differences in methods among years can affect the comparability and reliability of data. In the practical arena of salmon management, fishery biologists try to determine the amount of harvestable surplus and the number of spawners necessary to perpetuate the stock or run, known as the escapement goal.

Escapements of most Chinook salmon stocks in UCI have been monitored by single foot and aerial surveys. Such surveys provide only an index of escapement because we lack supporting data (i.e., accurate estimates of stream life and observer variability) to estimate number of fish in the escapement. The indices are a measurement on a numeric scale that provides information only about the relative level of the escapement. These measurements provide a ranking of escapement magnitude across years, but alone these measurements provide no information on the total number of fish in the escapement or of their age composition.

Hydroacoustics (sonar) have been used to assess early- and late-run Chinook salmon inriver runs to the Kenai River (Miller et al. 2005). An associated gillnetting program has been used to sample Chinook salmon to estimate age, sex, and size composition (Reimer 2004). Since 1995, the Deshka River Chinook salmon escapement has been counted and sampled at a weir, but in prior years escapement was indexed annually by single aerial surveys (Yanusz *In prep*). Chinook salmon escapement into the Deshka River prior to 1995 was estimated by expanding the aerial surveys in those years using the relationship between weir counts and survey indices observed since 1995. A weir project has also been in place to count and sample Chinook salmon in Crooked Creek (Gamblin et al. 2004). Sonar and weir data provides a count or an estimate of the total number of fish in the escapement.

For coho salmon stocks, escapements have been monitored with a combination of single foot surveys and weir counts (Bue and Hasbrouck *Unpublished*). Peak aerial surveys have been used to index escapement of chum salmon in Clearwater Creek, the only chum salmon stock in UCI that is monitored by ADF&G (Tobias and Willette 2007).

Sonar has been deployed to count or estimate sockeye salmon passing specific locations in the Crescent, Kasilof, Kenai, and Yentna rivers. Fish wheel catches were used to apportion sonar counts to species in these systems and to sample fish for age, sex, and size information

(Westerman and Willette 2006). Weirs have been installed to count and sample adult sockeye salmon escapements in the Russian River (Gamblin et al. 2004), Fish Creek (Sweet et al. 2004), and Packers Creek (Fandrei 1996).

Commercial catch statistics were compiled from ADF&G fish ticket information. The majority of sockeye salmon returning to UCI are caught in mixed stock fisheries (Shields 2007). A weighted age-composition apportionment method has been used to estimate stock-specific harvests of sockeye salmon in commercial gillnet fisheries in UCI (Tobias and Willette 2007). This method is based upon the assumption that age-specific exploitation rates were equal among stocks in the gillnet fishery (Bernard 1983) and is dependent upon accurate and precise escapement measures for all contributing stocks to the fishery. The age-composition catch apportionment method utilizes four data sources: (1) commercial harvests, (2) escapements into major UCI drainages, (3) age composition of harvests, and (4) age composition of escapements. Harvest allocation for each stock was estimated by harvest location and age composition. Estimates of sport harvest were derived from the postal survey (Statewide Harvest Survey) conducted annually by the Division of Sport Fish (Jennings et al. 2007).

ESCAPEMENT GOAL RECOMMENDATION

Escapement goals were evaluated for UCI stocks using the following methods: (1) Spawner-Return data; (2) Yield Analysis; (3) Smolt/Fry Information; and (4) Percentile Approach. Spawner-Return data was used to estimate escapement goals when the committee determined it had “good” estimates of total return (escapement and stock-specific harvest) for a stock. When “good” spawner-return data was available, escapement goals were estimated based on: (1) escapements producing average yields that were 90–100% of MSY (S_{MSY}) from a stock-recruitment model, and (2) the Yield Analysis, explained below, which also estimates MSY with corresponding 90–100% yield range. Smolt and/or fry information, when available, was used to aid in the estimation of escapement goals for stocks by examining the stability of freshwater productivity (average weight through time) and to better understand the effects of process error in marine versus freshwater environments. If marine survival is assumed to be largely density independent, a smolt stock-recruit production model provides improved estimates of yield related to spawners by eliminating marine environmental influences on survival.

Spawner-Return Data

Salmon spawner-return data were analyzed for all available brood years. Annual runs, the sum of escapements and harvests, were estimated as described in Bernard (1983). Where quantifiable, sport and subsistence harvests were included in total return estimates.

Spawner-return data were analyzed using a Ricker (1954) stock-recruitment model to estimate MSY and the escapement goal range. Results were not used if the model fit the data poorly ($p \geq 0.20$) or model assumptions were violated. Hilborn and Walters (1992), Quinn and Deriso (1999), and the CTC (1999) provide good descriptions of the Ricker model and diagnostics to assess model fit. All stock-recruitment models were tested and corrected for serial correlation of residuals when necessary. Additionally, the Ricker alpha parameter was corrected for the logarithm transformation bias induced into the model as described in Hilborn and Walters (1992) from fitting a regression line to ln(recruits/spawners) versus spawners.

Additional spawner-return analyses were conducted to examine stock productivity and the escapement goal for Kenai River sockeye salmon. Details about the various methods are provided in Clark et al. (2007). These analyses included:

(1) examination of a hierarchy of mathematical models that related number of spawners and adult recruitment of sockeye salmon;

(2) simulations using brood-interaction model parameters (Carlson et al. 1999) using the 1969–1999 spawner-recruit data and for the recent brood years 1979–1999 because the latter data set was obtained using more consistent methods for stock composition; and

(3) simulations testing the effects of alternating spawner abundances on yields in the brood-interaction model.

Yield Analysis

For the Kenai River sockeye salmon stock, Clark et al. (2007) conducted a Markov yield analysis (Hilborn and Walters 1992) to further evaluate the escapement goal range using three data sets: (1) the original spawner-recruit data set used in 1999, (2) an updated data set, and (3) a reduced data set. As in the original 1999 analysis, the yield table was constructed by partitioning the data into overlapping intervals of 200,000 spawners. The mean number of spawners, mean return, mean return per spawner, mean yield, and the range of yields was calculated for each interval of spawner abundance.

Percentile Approach

Most salmon stocks in UCI with an escapement goal have an SEG. In 2001, the SEG of these stocks was developed using percentiles of observed escapements, whether estimates or indices, that incorporated contrast in the escapement data and exploitation of the stock (Bue and Hasbrouck *Unpublished*). Percentile ranking is the percent of all escapement values that fall below a particular value. To calculate percentiles, escapement data are ranked from smallest to the largest value, with the smallest value the 0^{th} percentile (i.e., none of the escapement values are less than the smallest). The percentile of all remaining escapement values is a cumulative, or summation, of 1/(n-1), where n is the number of escapement values. Contrast in the escapement data is simply the maximum value divided by the minimum value. As contrast increased, the percentiles used to estimate the SEG were narrowed, primarily from the upper range, to allow the SEG to include a wide range of escapements. For exploited stocks with high contrast, the lower end of the SEG range was increased to the 25^{th} percentile as a precautionary measure for stock protection. The percentiles used at different levels of contrast were as follows (Bue and Hasbrouck *Unpublished*):

Escapement Contrast and Exploitation	SEG Range
Low Contrast (<4)	15^{th} Percentile to maximum observation
Medium Contrast (4 to 8)	15^{th} to 85^{th} Percentile
High Contrast (>8); Low Exploitation	15^{th} to 75^{th} Percentile
High Contrast (>8); Exploited Population	25^{th} to 75^{th} Percentile

For this review, the SEG ranges of all stocks were reevaluated using the percentile approach with updated or revised escapement data. If the estimated SEG range was consistent with the current goal (i.e., a high degree of overlap), the committee recommended no change to the goal.

RESULTS

There were 34 escapement goals evaluated for 32 stocks in UCI (Table 2). There were 32 existing escapement goals and 2 new goals for stocks that previously had goals. The recommendation for each escapement goal follows by species and river. The detailed information for each escapement goal can be found in the previous review reports (Clark et al. 2007; Hasbrouck and Edmundson 2007).

CHINOOK SALMON

Eagle River South Fork

The committee recommended that the Eagle River South Fork escapement goal for Chinook salmon be dropped. The sport harvest on this stock is very small (averaging less than 100 fish per year) and 5 of the past 6 surveys were poor quality, providing little information about escapements.

Campbell Creek

The committee recommended that the Campbell Creek Chinook salmon goal be re-instated to its previous level of 50 to 700 fish. During the 2004 review the goal was dropped because no fishery on this stock existed. In January of 2005 however, the BOF created a small youth-only fishery, which now warrants an escapement goal for this stock. The annual harvest for this fishery is approximately 100 fish (D. Bosch, Fishery Biologist, ADF&G, Division of Sport Fish, Region II; personal communication).

CHUM SALMON

The committee did not recommend any changes to the Clearwater Creek goal, the only chum salmon goal in UCI.

COHO SALMON

Campbell Creek

The committee recommended that the Campbell Creek escapement goal for coho salmon be dropped. Coho salmon runs to Campbell Creek are predominantly hatchery-stocked fish, with brood stock from Ship Creek.

SOCKEYE SALMON

Packers Creek

The committee recommended that the Packers Creek sockeye salmon goal be re-instated to its previous level of 15,000 to 30,000 before the 2004 review when it was dropped. In 2004, the committee dropped this goal because the weir had not operated since 2001. In 2005 however, a video counting system was installed for an annual assessment of escapement.

Fish Creek

The SEG for Fish Creek sockeye salmon is 20,000 to 70,000 fish after broodstock needs have been met (Appendix C2; CIAA 2007). Escapements during 2004–2006 were below the goal once (2005) and within the goal twice (Appendix C2).

The committee recommended no change to the SEG for Fish Creek sockeye salmon. Since 2002 this goal has been based on the percentile approach (Bue and Hasbrouck *Unpublished*; Hasbrouck and Edmundson 2007) applied to observed escapements from a time period prior to hatchery supplementation (1938–1978) so that the effects of supplementation did not influence yields and subsequent escapement of this stock. It was thought that a range of escapements from 20,000 to 70,000 fish would utilize available spawning areas, produce adequate numbers of juvenile salmon that would not tax the productive capacity of the lake, and sustain yields into the future.

Currently, this goal is evaluated using escapements of hatchery and naturally-produced fish because we can't manage fisheries to target hatchery fish. Hatchery supplementation of this stock began in 1979 and continues to the present (Dodson 2007). Prior to 1999 the hatchery did not mark fry released into the lake so there was no method to differentiate hatchery-produced from naturally-produced adults at the weir. Returning adults of hatchery origin have been differentiated from naturally produced fish at the weir from 2002 to the present. Although insufficient to assess the current goal, this information will prove useful in future evaluations of the escapement goal.

Fish used as broodstock in the hatchery program have not been (Bue and Hasbrouck *Unpublished*; Hasbrouck and Edmundson 2007) and should not be included in the evaluation of the escapement goal. These fish are used as a source of eggs and milt to produce fry that are stocked into Big Lake in the Fish Creek drainage and are also used to support hatchery programs in other waters (Dodson 2007). Broodstock do not contribute to the spawning escapement of the Fish Creek stock at the time of the evaluation of the escapement goal. Moreover, broodstock fish are not involved in the competition for spawning sites that may be a significant factor in the productive capacity of Fish Creek. Conversely, if rearing capacity is limiting production in the Fish Creek drainage, juveniles produced from broodstock and stocked back into Fish Creek would compete with naturally produced juvenile sockeye salmon. Competition from these hatchery-produced juveniles would likely be disproportionately greater than the naturally produced juveniles from an equivalent number of adult salmon taken during brood collection and evaluation of the escapement goal.

DISCUSSION

The committee recommended that most escapement goals for UCI salmon stocks remain status quo (Table 2). However, the Campbell Creek Chinook salmon and Packers Creek sockeye salmon goals that were dropped in the last review from 2004 were re-instated. Also, the Eagle River South Fork Chinook salmon and Campbell Creek coho salmon goals were dropped.

Historical escapement through 2006 and, when possible, harvest or total return data, of each stock appear in Appendices A–D. Through their respective time frames, data in the appendices were used in the review of escapement goals and development of SEGs of UCI salmon stocks in 2001 (Bue and Hasbrouck *Unpublished*), 2004 (Clark et al. 2007; Hasbrouck and Edmundson

2007), and in this review. Escapement values of some Chinook and coho salmon stocks were corrected because errors were discovered in the data.

It was recommended that the majority of current escapement goals for sockeye salmon in UCI remain unchanged. In this review, the committee did not have evidence to warrant a change in sockeye salmon escapement goals. However, some of the stocks underlying spawner-recruit data may be changed in the relatively near future using new information to allocate harvests.

The department has recently developed new, less expensive genetic techniques that are being used to estimate the stock composition of commercial sockeye salmon harvests in UCI for 2005 to 2007. It is anticipated that the results from these analyses will provide somewhat different estimates of harvest by stock for the major sockeye salmon producing stocks in UCI, and will thereby change the estimates of total run for these stocks. ADF&G has received General Fund monies to allow for the analysis of genetics samples each year. As time and funding allow, it is anticipated that select historical harvests will be genetically tested for stock composition and in conjunction with run strength, age composition, and run timing, modeled to re-estimate historical harvest composition by stock.

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TABLES AND FIGURES

Table 1.–List of members on the Alaska Department of Fish and Game (ADF&G) Upper Cook Inlet salmon escapement goal committee. Also provided is a list of other participants who assisted with the escapement goal review.

Name	Affiliation
Escapement Goal Committee:	
Lowell Fair	ADF&G, Division of Commercial Fisheries
Tracy Lingnau	ADF&G, Division of Commercial Fisheries
Scott Raborn	ADF&G, Division of Commercial Fisheries
Mark Willette	ADF&G, Division of Commercial Fisheries
Robert Begich	ADF&G, Division of Sport Fish
Bob Clark	ADF&G, Division of Sport Fish
James Hasbrouck	ADF&G, Division of Sport Fish
Tim McKinley	ADF&G, Division of Sport Fish
Dave Rutz	ADF&G, Division of Sport Fish
Tom Vania	ADF&G, Division of Sport Fish
Rich Yanusz	ADF&G, Division of Sport Fish
Other Participants:	
Doug Eggers	ADF&G, Division of Commercial Fisheries
Jeff Regnart	ADF&G, Division of Commercial Fisheries
Jim Seeb	ADF&G, Division of Commercial Fisheries
Matt Miller	ADF&G, Division of Sport Fish
George Pappas	ADF&G, Division of Sport Fish

Table 2.–Current escapement goals, escapements observed from 2004 through 2007, and escapement goal recommendations in 2007 for Chinook, chum, coho, and sockeye salmon stocks of Upper Cook Inlet, Alaska.

		Escapement Goal		Escapements [b]			
System	Escapement Data [a]	Type (BEG, SEG)	Range	2004	2005	2006	Recommendation [c]
Chinook Salmon							
Alexander Creek	SAS	SEG	2,100–6,000	2,215	2,140	885	NC
Campbell Creek	SFS	SEG	50–700	964	1,097	1,052	Re-instated previous SEG
Chuitna River	SAS	SEG	1,200–2,900	2,938	1,307	1,911	NC
Chulitna River	SAS	SEG	1,800–5,100	2,162	2,838	2,862	NC
Clear (Chunilna) Creek	SAS	SEG	950–3,400	3,417	1,924	1,520	NC
Crooked Creek [d]	Weir	SEG	650–1,700	2,196	1,903	1,516	NC
Deshka River	Weir	BEG	13,000–28,000	57,934 [e]	37,725	31,150	NC
Eagle River-S. Fork	SFS	SEG	50–350	47	32 [f]	13 [f]	Drop goal
Goose Creek	SAS	SEG	250–650	417	468	306	NC
Kenai River - Early Run	Sonar	BEG	4,000–9,000	11,855	16,387	18,560 [g]	NC
Kenai River - Late Run	Sonar	BEG	17,800–35,700	40,198	26,046	24,843 [g]	NC
Lake Creek	SAS	SEG	2,500–7,100	7,598	6,345	5,300	NC
Lewis River	SAS	SEG	250–800	1,000	441	341	NC
Little Susitna River	SAS	SEG	900–1,800	1,694	2,095	1,855	NC
Little Willow Creek	SAS	SEG	450–1,800	2,227	1,784	816	NC
Montana Creek	SAS	SEG	1,100–3,100	2,117	2,600	1,850	NC
Peters Creek	SAS	SEG	1,000–2,600	3,757	1,508	1,114	NC
Prairie Creek	SAS	SEG	3,100–9,200	5,570	3,862	3,570	NC
Sheep Creek	SAS	SEG	600–1,200	285	760	580	NC
Talachulitna River	SAS	SEG	2,200–5,000	8,352	4,406	6,152	NC
Theodore River	SAS	SEG	500–1,700	491	478	958	NC
Willow Creek [d]	SAS	SEG	1,600–2,800	2,840	2,411	2,193	NC
Chum Salmon							
Clearwater Creek	PAS	SEG	3,800–8,400	3,900	530	500	NC

-continued-

Table 2.–Page 2 of 2.

System	Escapement Data [a]	Escapement Goal Type (BEG, SEG)	Escapement Goal Range	Escapements [b] 2004	2005	2006	Recommendation [c]
Coho Salmon							
Campbell Creek	SFS	SEG	100–500	713	1,130	542	Drop goal
Jim Creek [h]	SFS	SEG	450–700	4,652	1,464	2,389	NC
Little Susitna River	Weir	SEG	10,100–17,700	40,199	16,839	8,786 [i]	NC
Pink Salmon							
No stocks with an escapement goal							
Sockeye Salmon							
Crescent River	Sonar	BEG	30,000–70,000	103,000	125,000	92,000	NC
Fish Creek (Knik) [j]	Weir	SEG	20,000–70,000	20,465	12,051	26,712	NC
Kasilof River	Sonar	BEG	150,000–250,000	575,000	346,000	366,000	NC
Kenai River	Sonar	SEG	500,000–800,000	1,120,000	1,113,000	1,270,000 [k]	NC
Packers Creek	Weir	SEG	15,000–30,000	NS	25,516	NS	Re-instated previous SEG
Russian River - Early Run	Weir	SEG	14,000–37,000	56,582	52,903	80,524	NC
Russian River - Late Run	Weir	SEG	30,000–110,000	110,244	54,808	84,432	NC
Yentna River	Sonar	SEG	90,000–160,000	71,281	36,921	92,045	NC

[a] SAS = Single Aerial Survey, PAS = Peak Aerial Survey, SFS = Single Foot Survey.
[b] NS = No Survey. Fish required to meet broodstock needs, in addition to meeting escapement goal, include 250 Chinook salmon at Crooked Creek and Deception Creek; 500 Chinook salmon at Ship Creek; 150 coho salmon at Jim Creek; 1,000 coho salmon at Ship Creek; 10,000 sockeye salmon at the Kasilof River; and 5,000 sockeye salmon at Fish Creek.
[c] NC = No Change.
[d] Escapement of naturally produced fish only.
[e] Weir count. Historic harvest upstream of weir = 1,005 Chinook salmon during 2000–2003.
[f] Poor survey count due to timing, weather, or poor visibility.
[g] Actual estimates of escapement not available until fall 2008 pending results from the Statewide Harvest Survey.
[h] Foot survey of McRoberts Creek only, upon which the SEG is based.
[i] Incomplete weir count due to flooding.
[j] The goal represents total spawner abundance minus sockeye salmon taken for broodstock.
[k] Used preliminary estimate of sport harvest upstream of sonar.

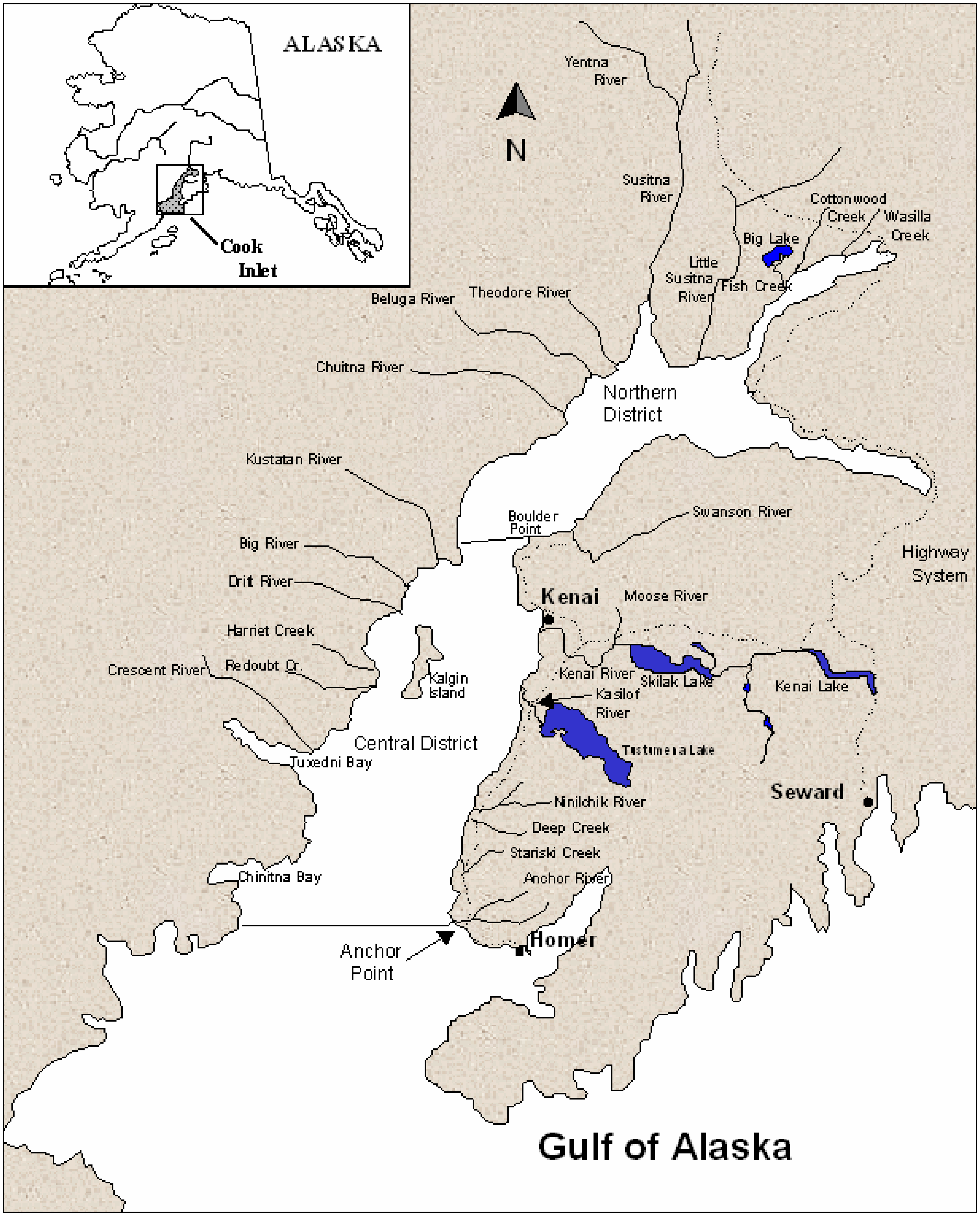

Figure 1.–Map of Upper Cook Inlet showing locations of the Northern and Central Districts and the primary salmon spawning drainages.

APPENDIX A.
SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR CHINOOK SALMON OF UPPER COOK INLET

Appendix A1.–Data available for analysis of escapement goals, Alexander Creek Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1974	2,193	
1975	1,878	
1976	5,412	
1977	9,246	
1978	5,854	
1979	6,215	712
1980		1,438
1981		1,121
1982	2,546	2,506
1983	3,755	1,711
1984	4,620	2,107
1985	6,241	2,761
1986	5,225	2,937
1987	2,152	2,224
1988	6,273	4,687
1989	3,497	4,882
1990	2,596	5,119
1991	2,727	6,548
1992	3,710	4,124
1993	2,763	5,154
1994	1,514	3,070
1995	2,090	1,217
1996	2,319	1,005
1997	5,598	1,470
1998	2,807	1,275
1999	3,974	2,241
2000	2,331	2,721
2001	2,282	2,313
2002	1,936	1,992
2003	2,012	2,293
2004	2,215	1,294
2005	2,140	1,052
2006	885	1,396

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007). Years with no harvest estimate occur because the escapement time series precedes the survey (begun in 1977) or harvest could not be estimated from survey data.

Appendix A2.–Data available for analysis of escapement goals, Campbell Creek Chinook salmon.

Year	Escapement [a]
1961	70
1962	40
1963	187
1964	116
1965	119
1966	15
1967	300
1968	125
1969	
1970	63
1971	102
1972	37
1973	201
1974	79
1975	
1976	210
1977	349
1978	
1979	
1980	
1981	
1982	68
1983	
1984	423
1985	
1986	733
1987	571
1988	
1989	218
1990	458
1991	590
1992	931
1993	937
1994	1,076
1995	734
1996	369
1997	1,119
1998	761
1999	1,035
2000	591
2001	717
2002	744
2003	747
2004	964
2005	1,097
2006	1,052

[a] Escapement not surveyed or monitored during years with no escapement value.

Appendix A3.–Data available for analysis of escapement goals, Chuitna River Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1977		227
1978		408
1979	1,246	78
1980		17
1981	1,362	115
1982	3,438	105
1983	4,043	1,185
1984	2,845	723
1985	1,600	734
1986	3,946	960
1987		146
1988	3,024	312
1989	990	581
1990	480	1,064
1991	537	377
1992	1,337	516
1993	2,085	893
1994	1,012	530
1995	1,162	201
1996	1,343	844
1997	2,232	728
1998	1,869	551
1999	3,721	561
2000	1,456	513
2001	1,501	457
2002	1,394	629
2003	2,339	592
2004	2,938	333
2005	1,307	294
2006	1,911	445

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007).

Appendix A4.–Data available for analysis of escapement goals, Chulitna River Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1982	863	
1983	4,058	
1984	4,191	
1985	783	
1986		
1987	5,252	
1988		
1989		
1990	2,681	
1991	4,410	
1992	2,527	
1993	2,070	
1994	1,806	
1995	3,460	
1996	4,172	43
1997	5,618	0
1998	2,586	41
1999	5,455	76
2000	4,218	10
2001	2,353	38
2002	9,002	0
2003		0
2004	2,162	0
2005	2,838	12
2006	2,862	0

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey for North Fork Chulitna River only (Jennings et al. 2007). Years with no harvest estimate occur because harvest could not be estimated from survey data.

Appendix A5.–Data available for analysis of escapement goals, Clear Creek Chinook salmon.

Year	Escapement [a]
1979	864
1980	
1981	
1982	982
1983	938
1984	1,520
1985	2,430
1986	
1987	
1988	4,850
1989	
1990	2,380
1991	1,974
1992	1,530
1993	886
1994	1,204
1995	1,928
1996	2,091
1997	5,100
1998	3,894
1999	2,216
2000	2,142
2001	2,096
2002	3,496
2003	
2004	3,417
2005	1,924
2006	1,520

[a] Escapement not surveyed or monitored during years with no escapement value.

Appendix A6.–Data available for analysis of escapement goals, Crooked Creek Chinook salmon.

Brood Year	Count at the Weir [a] Wild	Hatchery	Total	Actual Escapement [b] Total	Wild	Year	Sport Harvest [c] Early Run (thru 6/30)	Total
1976	1,682 [d]		1,682	1,537	1,537			
1977	3,069 [d]		3,069	2,390	2,390			
1978	4,535	180	4,715	4,388	4,220	1978		251
1979	2,774	770	3,544	3,177	2,487	1979		283
1980	1,764	518	2,282	2,115	1,635	1980		310
1981	1,871	1,033	2,904	2,919	1,881	1981		1,242
1982	1,449	2,054	3,503	4,107	1,699	1982		2,316
1983	1,543	2,762	4,305	3,842	1,377	1983		2,853
1984	1,372	2,278	3,650	3,409	1,281	1984		3,964
1985	1,175	1,637	2,812	2,491	1,041	1985		2,986
1986	1,539	2,335	3,874	4,055	1,611	1986		7,071
1987	1,444	2,280	3,724	3,344	1,297	1987		4,461
1988	1,174	2,622	3,796	700	216	1988		4,953
1989	1,081	1,930	3,011	750	269	1989		3,767
1990	1,066	1,581	2,647	1,663	670	1990		2,852
1991			2,281	893		1991		5,055
1992			3,533	843		1992		6,049
1993			2,291	657		1993		8,695
1994			1,790	640		1994		7,217
1995			2,206	750		1995		6,681
1996			2,224	764		1996	5,295	6,128
1997						1997	5,627	6,728
1998						1998	4,201	4,839
1999	602	1,189	1,791	1,503	505	1999	7,597	8,255
2000	662	752	1,414	1,100	515	2000	8,815	9,901
2001	2,122	462	2,584	3,023	1,381	2001	7,488	8,866
2002	2,506	797	3,303	3,254	958	2002	4,791	5,242
2003	2,923	1,204	4,127	4,780	2,554	2003	3,078	4,222
2004	2,641	2,232	4,873	4,674	2,196	2004	3,295	4,333
2005	2,107	1,055	3,162	2,923	1,903	2005	3,468	4,520
2006	1,589	1,056	2,645	2,568	1,516	2006	2,421	3,304

[a] Excludes age 0.1 fish. No weir count in 1997 and 1998.

[b] Number of fish estimated to have actually spawned. Includes fish counted during foot surveys below the weir. During all years fish were removed at the weir for brood stock and from 1988–1996 fish were also sacrificed for disease concerns.

[c] From Statewide Harvest Survey (Jennings et al. 2007) (large fish >20” only) for the Kasilof River sport fishery. Includes both wild and hatchery fish and an unknown number of late-run fish prior to 1996.

[d] Assumed wild.

Appendix A7.–Data available for analysis of escapement goals, Deshka River Chinook salmon.

Brood Year	Aerial Survey [a]	Spawning Escapement [b]	Weir Escapement	Total Return [a]	Yield	Return/ Spawner	Year	Sport Harvest [c]
1974	5,279	15,915		61,420	45,505	3.86	1974	
1975	4,737	14,840		33,603	18,764	2.26	1975	
1976	21,693	48,481		38,000	-10,480	0.78	1976	
1977	39,642	84,091		38,513	-45,579	0.46	1977	
1978	24,639	54,325		44,748	-9,577	0.82	1978	
1979	27,385	59,773		52,325	-7,448	0.88	1979	2,811
1980		35,132 [d]		44,840	9,708	1.28	1980	3,685
1981		23,605 [d]		44,783	21,178	1.90	1981	2,769
1982	16,000	37,186		75,172	37,986	2.02	1982	4,307
1983	19,237	43,608		36,457	-7,151	0.84	1983	4,889
1984	16,892	38,955		35,455	-3,501	0.91	1984	5,699
1985	18,151	41,453		47,362	5,909	1.14	1985	6,407
1986	21,080	47,264		31,066	-16,198	0.66	1986	6,490
1987	15,028	35,257		22,244	-13,013	0.63	1987	5,632
1988	19,200	43,534		21,472	-22,062	0.49	1988	5,474
1989		23,686 [d]		16,208	-7,478	0.68	1989	8,062
1990	18,166	41,483		6,988	-34,494	0.17	1990	6,161
1991	8,112	21,536		15,921	-5,614	0.74	1991	9,306
1992	7,736	20,790		43,081	22,291	2.07	1992	7,256
1993	5,769	16,887		31,748	14,860	1.88	1993	5,682
1994	2,665	10,729		30,309	19,580	2.83	1994	624
1995	5,150		10,048	52,974	42,926	5.27	1995	0
1996	6,343		14,349	25,488	11,139	1.78	1996	11
1997	19,047		35,587	33,599	-1,988	0.94	1997	42
1998	15,556	36,305		42,087	42,087	1.16	1998	3,384
1999	12,904		29,088	66,785	37,697	2.30	1999	3,496
2000 [e]			33,965				2000	7,075
2001 [e]			27,966				2001	5,007
2002 [e]	8,749		28,535				2002	4,508
2003 [e]			39,257				2003	6,605
2004 [e]	28,778		56,659				2004	9,050
2005 [e]	11,495		36,433				2005	7,332
2006 [e]	6,499		29,922				2006	7,753

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] Data used for spawner-recruit analysis. Aerial surveys were expanded, based on the relationship of aerial surveys to weir counts observed for 1995–2004, to obtain estimates of spawning escapement (Yanusz *In prep*).

[c] From Statewide Harvest Survey (Jennings et al. 2007). Years with no harvest estimate occur because the escapement time series precedes the survey (begun in 1977) or harvest could not be estimated from survey data.

[d] Based on average survey indices from nearby years for 1980 and an expectation-maximization (E-M) algorithm for 1981 and 1989 (Yanusz *In prep*), and regression expansion noted in footnote b.

[e] Complete return data not yet available.

Appendix A8.–Data available for analysis of escapement goals, Goose Creek Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1981	262	
1982	140	
1983	477	
1984	258	
1985	401	
1986	630	145
1987	416	334
1988	1,076	218
1989	835	385
1990	552	504
1991	968	288
1992	369	1,033
1993	347	633
1994	375	361
1995	374	226
1996	305	437
1997	308	298
1998	415	348
1999	268	371
2000	348	258
2001		160
2002	565	403
2003	175	350
2004	417	335
2005	468	150
2006	306	27

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007). Years with no harvest estimate occur because harvest could not be estimated from survey data.

Appendix A9.–Data available for analysis of escapement goals, Kenai River early-run Chinook salmon.

Year	Escapement	Total Return	Yield [a]	Return/ Spawner
1986	18,682	9,863	-8,819	0.53
1987	11,780	17,438	5,659	1.48
1988	5,331	20,736	15,404	3.89
1989	9,449	20,326	10,876	2.15
1990	8,494	19,716	11,222	2.32
1991	8,834	17,162	8,328	1.94
1992	7,610	11,008	3,398	1.45
1993	10,293	13,926	3,633	1.35
1994	9,947	21,814	11,867	2.19
1995	11,310	16,782	5,472	1.48
1996	16,595	8,857	-7,738	0.53
1997	8,185	12,516	4,331	1.53
1998	7,760	11,783	4,023	1.52
1999	17,276	21,101	3,825	1.22
2000 [b]	10,476			
2001 [b]	14,982			
2002 [b]	6,185			
2003 [b]	10,097			
2004 [b]	11,855			
2005 [b]	16,387			
2006 [b]	18,560			

[a] Yield is total return minus escapement.

[b] Complete return data not yet available.

Appendix A10.–Data available for analysis of escapement goals, Kenai River late-run Chinook salmon.

Year		Escapement	Total Return	Yield [a]	Return/ Spawner
1986		47,375	47,475	99	1.00
1987		34,900	65,177	30,278	1.87
1988		32,137	71,743	39,605	2.23
1989		19,256	44,111	24,855	2.29
1990		26,508	49,078	22,570	1.85
1991		26,695	69,694	42,998	2.61
1992		22,524	48,784	26,260	2.17
1993		33,738	47,132	13,394	1.40
1994		35,065	53,482	18,417	1.53
1995		31,255	53,697	22,442	1.72
1996		30,907	39,270	8,363	1.27
1997		26,297	43,586	17,289	1.66
1998		26,768	67,840	41,072	2.53
1999		34,962	99,135	64,173	2.84
2000	[b]	29,627			
2001	[b]	17,947			
2002	[b]	30,464			
2003	[b]	23,736			
2004	[b]	40,198			
2005	[b]	26,046			
2006	[b]	24,843			

[a] Yield is total return minus escapement.

[b] Complete return data not yet available.

Appendix A11.–Data available for analysis of escapement goals, Lake Creek Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1979	4,196	1,796
1980		775
1981		795
1982	3,577	1,645
1983	7,075	2,423
1984		2,881
1985	5,803	2,575
1986		2,134
1987	4,898	3,282
1988	6,633	2,784
1989		3,554
1990	2,075	3,423
1991	3,011	2,712
1992	2,322	3,668
1993	2,869	6,425
1994	1,898	3,548
1995	3,017	2,838
1996	3,514	2,587
1997	3,841	3,777
1998	5,056	2,511
1999	2,877	3,037
2000	4,035	4,611
2001	4,661	4,067
2002	4,852	2,878
2003	8,153	4,467
2004	7,598	3,657
2005	6,345	4,508
2006	5,300	4,070

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007).

Appendix A12.–Data available for analysis of escapement goals, Lewis River Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1977		9
1978		12
1979	546	
1980		
1981	560	
1982	606	
1983		
1984	947	
1985	861	100
1986	722	
1987	875	185
1988	616	246
1989	452	190
1990	207	285
1991	303	16
1992	445	
1993	531	27
1994	164	
1995	146	
1996	257	
1997	777	
1998	626	
1999	675	
2000	480	
2001	502	
2002	439	0
2003	878	0
2004	1,000	0
2005	441	0
2006	341	0

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007). Years with no harvest estimate occur because harvest could not be estimated from survey data.

Appendix A13.–Data available for analysis of escapement goals, Little Susitna River Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1977		191
1978		93
1979		800
1980		646
1981		1,418
1982		1,467
1983	929	1,187
1984	558	1,883
1985	1,005	1,845
1986		1,457
1987	1,386	2,282
1988	3,197	2,822
1989	2,184	4,204
1990	922	1,965
1991	892	2,102
1992	1,441	3,920
1993		3,441
1994	1,221	4,204
1995	1,714	1,698
1996	1,079	1,484
1997		2,938
1998	1,091	2,031
1999		2,713
2000	1,094	2,803
2001	1,238	2,243
2002	1,660	3,144
2003	1,114	2,138
2004	1,694	2,362
2005	2,095	2,724
2006	1,855	3,303

[a] Escapement not surveyed or monitored during years with no escapement value. No aerial survey conducted in 1989; however, in 1988, 1989, 1994, and 1995 a weir was operated on the Little Susitna River. Based on the relationship of weir counts to aerial surveys in 1988, 1994, and 1995, 50% of the 1989 weir count of 4,367 Chinook salmon was used for an index of escapement.

[b] From Statewide Harvest Survey (Jennings et al. 2007).

Appendix A14.–Data available for analysis of escapement goals, Little Willow Creek Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1979	327	0
1980		32
1981	459	0
1982	316	0
1983	1,042	0
1984		37
1985	1,305	25
1986	2,133	872
1987	1,320	711
1988	1,515	937
1989	1,325	507
1990	1,115	387
1991	498	684
1992	673	1,023
1993	705	1,200
1994	712	745
1995	1,210	436
1996	1,077	896
1997	2,390	699
1998	1,782	546
1999	1,837	1,344
2000	1,121	577
2001	2,084	941
2002	1,680	580
2003	879	510
2004	2,227	445
2005	1,784	621
2006	816	449

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007).

Appendix A15.–Data available for analysis of escapement goals, Montana Creek Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1981	814	661
1982		241
1983		504
1984		1,522
1985		979
1986		2,796
1987	1,320	1,726
1988	2,016	1,070
1989		1,708
1990	1,269	478
1991	1,215	575
1992	1,560	3,078
1993	1,281	4,054
1994	1,143	3,111
1995	2,110	1,004
1996	1,841	1,612
1997	3,073	2,181
1998	2,936	1,471
1999	2,088	3,279
2000	1,271	1,728
2001	1,930	2,646
2002	2,357	2,026
2003	2,576	1,242
2004	2,117	1,071
2005	2,600	1,328
2006	1,850	1,672

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007).

Appendix A16.–Data available for analysis of escapement goals, Peters Creek Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1983	2,272	
1984	324	112
1985	2,901	
1986	1,915	
1987	1,302	
1988	3,927	549
1989	959	339
1990	2,027	385
1991	2,458	495
1992	996	655
1993	1,668	283
1994	573	202
1995	1,041	252
1996	749	74
1997	2,637	34
1998	4,367	74
1999	3,298	197
2000	1,648	236
2001	4,226	88
2002	2,959	52
2003	3,998	122
2004	3,757	85
2005	1,508	0
2006	1,114	33

[a] In 1983 only a tributary was surveyed, not the mainstem of Peters Creek.

[b] From Statewide Harvest Survey (Jennings et al. 2007). Years with no harvest estimate occur because harvest could not be estimated from survey data.

Appendix A17.–Data available for analysis of escapement goals, Prairie Creek Chinook salmon.

Year	Escapement
1981	1,875
1982	3,844
1983	3,200
1984	9,000
1985	6,500
1986	8,500
1987	9,138
1988	9,280
1989	9,463
1990	9,113
1991	6,770
1992	4,453
1993	3,023
1994	2,254
1995	3,884
1996	5,037
1997	7,710
1998	4,465
1999	5,871
2000	3,790
2001	5,191
2002	7,914
2003	4,095
2004	5,570
2005	3,862
2006	3,570

Appendix A18.–Data available for analysis of escapement goals, Sheep Creek Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1979	778	10
1980		45
1981	1,013	0
1982	527	0
1983	975	0
1984	1,028	0
1985	1,634	0
1986	1,285	1,778
1987	895	1,610
1988	1,215	1,847
1989	610	1,116
1990	634	1,537
1991	154	1,519
1992		2,663
1993		2,300
1994	542	1,349
1995	1,049	746
1996	1,028	1,397
1997		550
1998	1,160	700
1999		2,558
2000	1,162	852
2001		1,420
2002	854	928
2003		1,284
2004	285	914
2005	760	878
2006	580	707

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007).

Appendix A19.–Data available for analysis of escapement goals, Talachulitna River Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1979	1,648	293
1980		121
1981	2,025	57
1982	3,101	0
1983	10,014	336
1984	6,138	424
1985	5,145	224
1986	3,686	201
1987		116
1988	4,112	909
1989		403
1990	2,694	709
1991	2,457	848
1992	3,648	445
1993	3,269	875
1994	1,575	927
1995	2,521	509
1996	2,748	697
1997	4,494	778
1998	2,759	563
1999	4,890	977
2000	2,414	694
2001	3,309	409
2002	7,824	508
2003	9,573	587
2004	8,352	344
2005	4,406	800
2006	6,152	452

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007).

Appendix A20.–Data available for analysis of escapement goals, Theodore River Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1977		237
1978		58
1979	512	20
1980		17
1981	535	77
1982	1,368	42
1983	1,519	0
1984	1,251	1,110
1985	1,458	1,195
1986	1,281	1,418
1987	1,548	1,146
1988	1,906	1,137
1989	1,026	1,317
1990	642	748
1991	508	369
1992	1,053	522
1993	1,110	527
1994	577	581
1995	694	360
1996	368	183
1997	1,607	0
1998	1,807	0
1999	2,221	0
2000	1,271	0
2001	1,237	21
2002	934	0
2003	1,059	13
2004	491	0
2005	478	0
2006	958	0

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007).

Appendix A21.–Data available for analysis of escapement goals, Willow Creek Chinook salmon.

Year	Escapement [a]	Sport Harvest [b]
1979	848	459
1980		289
1981	991	585
1982	592	629
1983	777	534
1984	2,789	774
1985	1,856	1,063
1986	2,059	1,017
1987	2,768	1,987
1988	2,496	2,349
1989	5,060	2,846
1990	2,365	3,237
1991	2,006	3,208
1992	1,660	8,884
1993	2,227	8,626
1994	1,479	5,980
1995	3,792	2,742
1996	1,776	2,690
1997	4,841	3,135
1998	3,500	2,793
1999	2,081	4,988
2000	2,601	3,782
2001	3,132	4,573
2002	2,553	3,591
2003	3,855	3,922
2004	2,840	2,818
2005	2,411	2,466
2006	2,193	2,141

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007) which includes harvest for the entire drainage, including wild and hatchery produced fish of Deception Creek origin.

APPENDIX B.
SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR COHO SALMON OF UPPER COOK INLET

Appendix B1.–Data available for analysis of escapement goals, Jim Creek coho salmon.

Year	Escapement [a]	Sport Harvest [b]
1981		1,801
1982		2,306
1983		774
1984		3,429
1985	662	2,523
1986	439	2,948
1987	667	3,676
1988	1,911	11,078
1989	597	4,220
1990	599	6,184
1991	484	2,920
1992	11	3,409
1993	503	2,878
1994	506	3,946
1995	702	3,549
1996	72	3,911
1997	701	1,786
1998	922	4,197
1999	12	2,612
2000	657	5,653
2001	1,019	8,374
2002	2,473	14,707
2003	1,421	6,415
2004	4,652	11,766
2005	1,464	10,114
2006	2,389	19,256

[a] Escapement for McRoberts Creek only, a tributary to Jim Creek. Escapement not surveyed or monitored during years with no escapement value.

[b] From Statewide Harvest Survey (Jennings et al. 2007) for Knik River and tributaries including Jim Creek.

Appendix B2.–Data available for analysis of escapement goals, Little Susitna River coho salmon.

Year	Total Escapement [a]	% Hatchery Contribution to Escapement [b]	Escapement Hatchery	Escapement Wild	Sport Harvest [c]
1977					3,415
1978					4,865
1979					3,382
1980					6,302
1981					5,940
1982					7,116
1983					2,835
1984					14,253
1985					7,764
1986	6,999			6,999	6,039
1987					13,003
1988	20,491	22	4,428	16,063	19,009
1989	15,232	45	6,862	8,370	14,129
1990	14,310	24	3,370	10,940	7,497
1991	37,601	22	8,322	29,279	16,450
1992	20,393	11	2,324	18,069	20,033
1993	33,378	29	9,615	23,763	27,610
1994	27,820	18	5,124	22,696	17,665
1995	11,817	9	1,069	10,748	14,451
1996	16,699	3	444	16,255	16,753
1997	9,894			9,894	7,756
1998	15,159			15,159	14,469
1999	3,017			3,017	8,864
2000	15,436			15,436	20,357
2001	30,587			30,587	17,071
2002	47,938			47,938	19,278
2003	10,877			10,877	13,672
2004	40,199			40,199	15,307
2005	16,839			16,839	10,203
2006	8,786			8,786	12,399

[a] Escapement not surveyed or monitored during years with no escapement value.

[b] Based on sampling and coded wire tag data collected at the weir in 1988–1996. Hatchery stocking program ended in 1995, thus no hatchery produced fish in the coho salmon run since 1997.

[c] From Statewide Harvest Survey (Jennings et al. 2007).

APPENDIX C. SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR SOCKEYE SALMON OF UPPER COOK INLET

Appendix C1.–Data available for analysis of escapement goals, Crescent River sockeye salmon.

Year	Escapement [a]	Total Return	Yield [a]	Return/ Spawner
1975	41,000	216,000	175,000	5.27
1976	51,000	52,000	1,000	1.02
1977	87,000	99,000	12,000	1.14
1978	74,000	245,000	171,000	3.31
1979	86,654	245,000	158,346	2.83
1980	90,863	275,000	184,137	3.03
1981	41,213	163,000	121,787	3.96
1982	58,957	168,000	109,043	2.85
1983	92,122	182,000	89,878	1.98
1984	118,345	114,000	-4,345	0.96
1985	128,628	54,000	-74,628	0.42
1986 [b]	95,000	90,000	-5,000	0.95
1987	120,219	64,000	-56,219	0.53
1988	57,716	51,000	-6,716	0.88
1989	71,064	80,000	8,936	1.13
1990	52,238	42,000	-10,238	0.80
1991	44,578	55,000	10,422	1.23
1992	58,229	85,000	26,771	1.46
1993	37,556	91,000	53,444	2.42
1994	30,355	88,000	57,645	2.90
1995	52,311	138,000	85,689	2.64
1996	28,729	76,000	47,271	2.65
1997	70,768	100,000	29,232	1.41
1998	62,257	180,000	117,743	2.89
1999	66,519	159,000	92,481	2.39
2000	56,599	178,000	121,401	3.14
2001 [c]	78,081			
2002 [c]	62,833			
2003 [c]	122,457			
2004 [c]	103,201			
2005 [c]	125,623			
2006 [c]	92,533			

[a] Escapement was estimated by sonar beginning in 1975.

[b] In 1986, the sonar operation was terminated earlier than usual on July 16. A total of 20,385 sockeye salmon had been counted through that date. To account for the missing period, total sockeye salmon escapement in 1986 was estimated using the exploitation rate through July 13 and total Western Subdistrict catch.

[c] Complete return data not yet available.

Appendix C2.–Data available for analysis of escapement goals, Fish Creek sockeye salmon.

Year	Escapement [a]		Year	Escapement [a]	
1938	182,463		1973	2,705	e
1939	116,588		1974	16,225	f
1940	306,982		1975	29,882	
1941	55,077		1976	14,032	
1942			1977	5,183	
1943			1978	3,555	
1944			1979	68,739	g
1945			1980	62,828	g
1946	57,000	b	1981	50,479	g
1947	150,000	b	1982	28,164	g
1948	150,000	b	1983	118,797	g
1949	68,240		1984	192,352	g
1950	29,659		1985	68,577	g
1951	34,704		1986	29,800	g
1952	92,724		1987	91,215	g
1953	54,343		1988	71,603	g
1954	20,904		1989	67,224	g
1955	32,724		1990	50,000	g
1956	32,663	c	1991	50,500	g
1957	15,630		1992	71,385	g
1958	17,573		1993	117,619	g
1959	77,416	c,d	1994	95,107	g
1960	80,000	c,d	1995	115,000	g
1961	40,000	c,d	1996	63,160	g
1962	60,000	c,d	1997	54,656	g
1963	119,024	c,d	1998	22,853	g
1964	65,000	c,d	1999	26,746	g
1965	16,544	c,d	2000	19,533	g
1966	41,312	c,d	2001	43,469	g
1967	22,624	c,d	2002	90,483	g
1968	19,616	c,d	2003	92,298	g
1969	12,456		2004	22,157	g
1970	25,000		2005	14,215	g
1971	31,900		2006	32,562	g
1972	6,981				

[a] Data for 1979–2000 were excluded from analyses because hatchery stocks were present.

[b] Escapement enumerated by ground surveys.

[c] Escapement enumerated using a counting screen.

[d] Includes 3,500 sockeye salmon behind weir when it washed out on 8/8/70.

[e] Includes 500 sockeye salmon behind weir when it was removed on 8/7/71.

[f] Counting occurred downstream of Knik Road prior to 1983, at South Big Lake Road. From 1983–1991, and at Lewis Road from 1992–present.

[g] Partial counts due to termination of counting before the end of the run.

Appendix C3.–Data available for analysis of escapement goals, Kasilof River sockeye salmon.

Year	Escapement [a]	Total Return	Yield [a]	Return/ Spawner	Hatchery Release (millions) [b]
1975	44,000	365,000	321,000	8.30	1.14
1976	133,000	757,000	624,000	5.69	0.00
1977	153,000	696,000	543,000	4.55	0.40
1978	109,000	811,000	702,000	7.44	7.76
1979	149,000	869,000	720,000	5.83	5.21
1980	178,000	1,207,000	1,029,000	6.78	8.78
1981	246,000	2,059,000	1,813,000	8.37	15.95
1982	168,000	1,457,000	1,289,000	8.67	16.94
1983	199,000	1,040,000	841,000	5.23	17.05
1984	219,000	830,000	611,000	3.79	16.39
1985	493,000	421,000	-72,000	0.85	13.56
1986	263,000	789,000	526,000	3.00	15.53
1987	235,000	1,076,000	841,000	4.58	6.27
1988	141,000	755,000	614,000	5.35	6.01
1989	149,000	581,000	432,000	3.90	6.01
1990	137,000	564,000	427,000	4.12	6.00
1991	228,000	1,062,000	834,000	4.66	6.06
1992	176,000	925,000	749,000	5.26	6.00
1993	140,000	585,000	445,000	4.18	0.00
1994	190,000	858,000	668,000	4.52	6.00
1995	191,000	580,000	389,000	3.04	6.14
1996	237,000	803,000	566,000	3.39	5.98
1997	256,000	746,000	490,000	2.91	4.56
1998	262,000	889,000	627,000	3.39	5.95
1999	301,000	1,321,000	1,020,000	4.39	5.43
2000	245,000	1,495,000	1,250,000	6.10	0.00
2001 [c]	297,000				6.07
2002 [c]	216,000				6.02
2003 [c]	347,000				6.01
2004 [c]	575,000				6.00
2005 [c]	346,000				0.00
2006 [c]	366,000				0.00

[a] The hatchery component of the escapement was removed.

[b] Hatchery release arranged by brood year.

[c] Complete return data not yet available.

Appendix C4.–Data available for analysis of escapement goals, Kenai River sockeye salmon (excludes late-run Russian River escapement through the weir and Hidden Lake enhanced).

Year	Escapement	Total Return	Yield	Return/ Spawner
1968	82,180	916,445	834,265	11.15
1969	51,850	409,481	357,631	7.90
1970	72,400	519,828	447,428	7.18
1971	289,270	862,669	573,399	2.98
1972	301,950	2,185,543	1,883,593	7.24
1973	358,070	1,995,399	1,637,329	5.57
1974	144,470	665,130	520,660	4.60
1975	128,500	895,207	766,707	6.97
1976	353,161	1,186,922	833,761	3.36
1977	663,627	2,810,690	2,147,063	4.24
1978	349,828	3,450,735	3,100,907	9.86
1979	245,850	1,110,592	864,742	4.52
1980	397,557	2,345,553	1,947,996	5.90
1981	359,344	2,267,624	1,908,280	6.31
1982	566,034	8,929,594	8,363,560	15.78
1983	566,652	8,697,304	8,130,652	15.35
1984	309,514	3,251,505	2,941,991	10.51
1985	396,032	2,245,906	1,849,874	5.67
1986	400,302	1,740,938	1,340,636	4.35
1987	1,333,136	9,530,501	8,197,365	7.15
1988	838,851	2,119,694	1,280,843	2.53
1989	1,333,687	3,898,327	2,564,640	2.92
1990	439,052	1,333,864	894,812	3.04
1991	376,149	3,926,048	3,549,899	10.44
1992	752,239	3,468,728	2,716,489	4.61
1993	669,758	1,287,000	617,242	1.92
1994	894,646	2,549,000	1,654,354	2.85
1995	520,778	1,490,000	969,222	2.86
1996	578,927	1,887,000	1,308,073	3.26
1997	872,041	3,136,000	2,263,959	3.60
1998	551,891	3,654,000	3,102,109	6.62
1999	582,907	5,159,000	4,576,093	8.85
2000	393,154	6,291,000	5,897,846	16.00
2001 [a]	457,760			
2002 [a]	700,549			
2003 [a]	938,398			
2004 [a]	1,120,000			
2005 [a]	1,113,000			
2006 [a]	1,270,000			

[a] Complete return data not yet available.

Appendix C5.–Data available for analysis of escapement goals, Packers Lake sockeye salmon.

Year	Escapement [a]
1974	2,123
1975	4,522
1976	13,292
1977	16,934
1978	23,651
1979	37,755
1980	28,520
1981	12,934
1982	15,687
1983	18,403
1984	30,403
1985	36,864
1986	29,604
1987	35,401
1988	18,607
1989	22,304
1990	31,868
1991	41,275
1992	30,143
1993	40,869
1994	30,776
1995	29,473
1996	16,971
1997	31,439
1998	17,728
1999	25,648
2000	20,151
2001	
2002	
2003	
2004	
2005	22,000
2006	

[a] Only weir data from 1974–1989 were used in calculating the goal.

Appendix C6.–Table of data available for analysis of escapement goals, early-run Russian River sockeye salmon.

Brood Year	Escapement [a]	Total Return	Yield	Return/ Spawner	Year	Harvest [b]
1965	21,510	5,970	-15,540	0.28	1965	10,030
1966	16,660	7,822	-8,838	0.47	1966	14,950
1967	13,710	18,662	4,952	1.36	1967	7,240
1968	9,120	19,800	10,680	2.17	1968	6,920
1969	5,000	13,169	8,169	2.63	1969	5,870
1970	5,450	12,642	7,192	2.32	1970	5,750
1971	2,650	8,728	6,078	3.29	1971	2,810
1972	9,270	98,980	89,710	10.68	1972	5,040
1973	13,120	26,788	13,668	2.04	1973	6,740
1974	13,160	52,849	39,689	4.02	1974	6,440
1975	5,650	14,130	8,480	2.50	1975	1,400
1976	14,735	115,408	100,673	7.83	1976	3,380
1977	16,060	17,515	1,455	1.09	1977	20,400
1978	34,240	17,001	-17,239	0.50	1978	37,720
1979	19,750	94,836	75,086	4.80	1979	8,400
1980	28,620	42,401	13,781	1.48	1980	27,220
1981	21,140	76,040	54,900	3.60	1981	10,720
1982	56,110	278,179	222,069	4.96	1982	34,500
1983	21,270	23,549	2,279	1.11	1983	8,360
1984	28,900	42,857	13,957	1.48	1984	35,880
1985	30,610	43,776	13,166	1.43	1985	12,300
1986	36,340	90,637	54,297	2.49	1986	35,100
1987	61,510	109,215	47,705	1.78	1987	154,200
1988	50,410	87,848	37,438	1.74	1988	54,780
1989	15,340	57,055	41,715	3.72	1989	11,290
1990	26,720	94,893	68,173	3.55	1990	30,215
1991	32,389	126,044	93,655	3.89	1991	65,390
1992	37,117	64,978	27,861	1.75	1992	30,512
1993	39,857	41,584	1,727	1.04	1993	37,261
1994	44,872	114,649	69,777	2.56	1994	48,923
1995	28,603	26,462	-2,141	0.93	1995	23,572
1996	52,905	192,657	139,752	3.64	1996	39,075
1997	36,280	63,876	27,596	1.76	1997	36,788
1998	34,143	57,692	23,549	1.69	1998	42,711
1999	36,607	106,219	69,612	2.90	1999	34,283
2000	32,736	94,932	62,196	2.90	2000	40,732
2001 [c]	78,255	20,468			2001	35,400
2002 [c]	85,943				2002	52,139
2003 [c]	23,650				2003	22,986
2004 [c]	56,582				2004	32,727
2005 [c]	52,903				2005	37,139
2006 [c]	80,524				2006	51,167

[a] Escapements of brood years 1965–1968 from tower counts and of 1969–2000 from weir counts.

[b] Harvest during 1965–1996 from an onsite creel survey and during 1997–2000 from Statewide Harvest Survey (Jennings et al. 2007). Estimates are only of fish harvested near the Russian River itself.

[c] Complete return data not yet available.

Appendix C7.–Data available for analysis of escapement goals, late-run Russian River sockeye salmon.

Year	Harvest [a]	Escapement [b] Above Weir	Escapement [b] Below Weir	Local Return
1963	1,390	51,120	Unknown	52,510
1964	2,450	46,930	Unknown	49,380
1965	2,160	21,820	Unknown	23,980
1966	7,290	34,430	Unknown	41,720
1967	5,720	49,480	Unknown	55,200
1968	5,820	48,880	4,200	58,900
1969	1,150	28,870	1,100	31,120
1970	600	26,200	220	27,020
1971	10,730	54,420	10,000	75,150
1972	16,050	79,115	6,000	101,165
1973	8,930	25,070	6,680	40,680
1974	8,500	24,900	2,210	35,610
1975	8,390	31,960	690	41,040
1976	13,700	31,940	3,470	49,110
1977	27,440	21,360	17,090	65,890
1978	24,530	34,340	18,330	77,200
1979	26,840	87,850	3,920	118,610
1980	33,500	83,980	3,220	120,700
1981	23,720	44,520	4,160	72,400
1982	10,320	30,800	45,000	86,120
1983	16,000	33,730	44,000	93,730
1984	21,970	92,660	3,000	117,630
1985	58,410	136,970	8,650	204,030
1986	30,810	40,280	15,230	86,320
1987	40,580	53,930	76,530	171,040
1988	19,540	42,480	30,360	92,380
1989	55,210	138,380	28,480	222,070
1990	56,180	83,430	11,760	151,370
1991	31,450	78,180	22,270	131,900
1992	26,101	63,478	4,980	94,559
1993	26,772	99,259	12,258	138,289
1994	26,375	122,277	15,211	163,863
1995	11,805	61,982	12,479	86,266
1996	19,136	34,691	31,601	85,428
1997	12,910	65,905	11,337	90,152
1998	25,110	113,477	19,593	158,180
1999	32,335	139,863	19,514	191,712
2000	30,229	56,580	13,930	100,739
2001	18,550	74,964	17,044	110,558
2002	31,999	62,115	6,858	100,972
2003	28,085	157,469	27,474	213,028
2004	22,417	110,244	30,458	163,119
2005	18,503	54,808	29,048	102,359
2006	29,694	84,432	18,452	132,578

[a] Harvest during 1963–1996 from an onsite creel survey and during 1997–2000 from Statewide Harvest Survey (Jennings et al. 2007). Estimates are only of fish harvested near the Russian River itself.

[b] Escapements of brood years 1963–1968 from tower counts and of 1969–2000 from weir counts.

Appendix C8.–Data available for analysis of escapement goals, Yentna River sockeye salmon.

Year	Escapement
1981	139,401
1982	113,847
1983	104,414
1984	149,375
1985	107,124
1986	92,076
1987	66,054
1988	52,330
1989	96,269
1990	140,290
1991	109,632
1992	66,074
1993	141,694
1994	128,032
1995	121,220
1996	90,660
1997	157,822
1998	119,623
1999	99,029
2000	133,094
2001	83,532
2002	78,591
2003	180,813
2004	71,281
2005	36,921
2006	92,045

APPENDIX D.
SUPPORTING INFORMATION FOR ESCAPEMENT GOALS FOR CHUM SALMON OF UPPER COOK INLET

Appendix D1.–Data available for analysis of escapement goals, Clearwater Creek chum salmon.

Year	Escapement [a]
1971	5,000
1972	
1973	8,450
1974	1,800
1975	4,400
1976	12,500
1977	12,700
1978	6,500
1979	1,350
1980	5,000
1981	6,150
1982	15,400
1983	10,900
1984	8,350
1985	3,500
1986	9,100
1987	6,350
1988	
1989	2,000
1990	5,500
1991	7,430
1992	8,000
1993	1,130
1994	3,500
1995	3,950
1996	5,665
1997	8,230
1998	2,710
1999	6,400
2000	31,800
2001	14,570
2002	8,864
2003	7,200
2004	3,900
2005	530
2006	500

[a] Escapement not surveyed or monitored during years with no escapement value.