Fishery Data Series No. 95-3

Stock Assessment of the Return of Late-run Chinook Salmon to the Kenai River, 1994

by

S. L. Hammarstrom

March 1995

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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STOCK ASSESSMENT OF THE RETURN OF LATE-RUN CHINOOK SALMON TO THE KENAI RIVER, 1994

by

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ABSTRACT

The estimated total return of late-run chinook salmon *Oncorhynchus tshawytscha* to the Kenai River in 1994 was 71,899. This estimate includes fish harvested in the recreational marine fishery near Deep Creek, which was estimated by creel survey for the first time since 1986. The total harvest in the marine recreational fishery, the marine commercial gillnet fisheries (drift and set), the marine subsistence set gillnet fishery, the inriver subsistence dip net fishery, and Kenaitze Indian educational set gillnet fishery was 18,618. The total inriver return of late-run chinook salmon estimated through hydroacoustic techniques was 53,281. The estimated angler effort and harvest measured from a creel survey during the late chinook salmon run were 354,778 angler-hours and 14,388 chinook salmon, respectively.

Release mortality was estimated at 344 fish. Spawning escapement, which was estimated by subtracting total fishing mortality from total inriver return, was 38,549 and met spawning requirements stipulated in the management plan. The predominant age class of the commercial harvest, inriver return, and recreational harvest was age-1.4 fish.

Migratory timing models were used to project spawning escapement during the 1994 fishery. No additional restrictions to the fishery were required to achieve escapement goals. A relatively strong return allowed for an additional 8 days of recreational fishing; 1 day in July and 7 days in August.

A sibling model was used to forecast the 1995 return of chinook salmon to the Kenai River at 74,615 (SE = 23,963) fish.

Production from the 1985 brood was 1.86 returning fish-per-spawner. However, production from the 1986 brood will approximate replacement. Production from the 1987 brood has been 1.79 returning fish-per-spawner. Production from the 1988 brood has been 2.02 returning fish-per-spawner with age 7 and 8 to return in 1995 and 1996, respectively.

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

INTRODUCTION

The largest freshwater recreational fishery in Alaska occurs in the Kenai River with an average of nearly 350,000 angler-days of effort each year from 1983-1993 (Mills 1984-1994). This represents approximately 15% of the state's recreational fishing effort. The majority of the angler effort occurs in the section of the river between the Soldotna Bridge and Cook Inlet (Figure 1) during a fishery directed primarily at returning chinook salmon *Oncorhynchus tshawytscha* during May, June, and July.

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

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

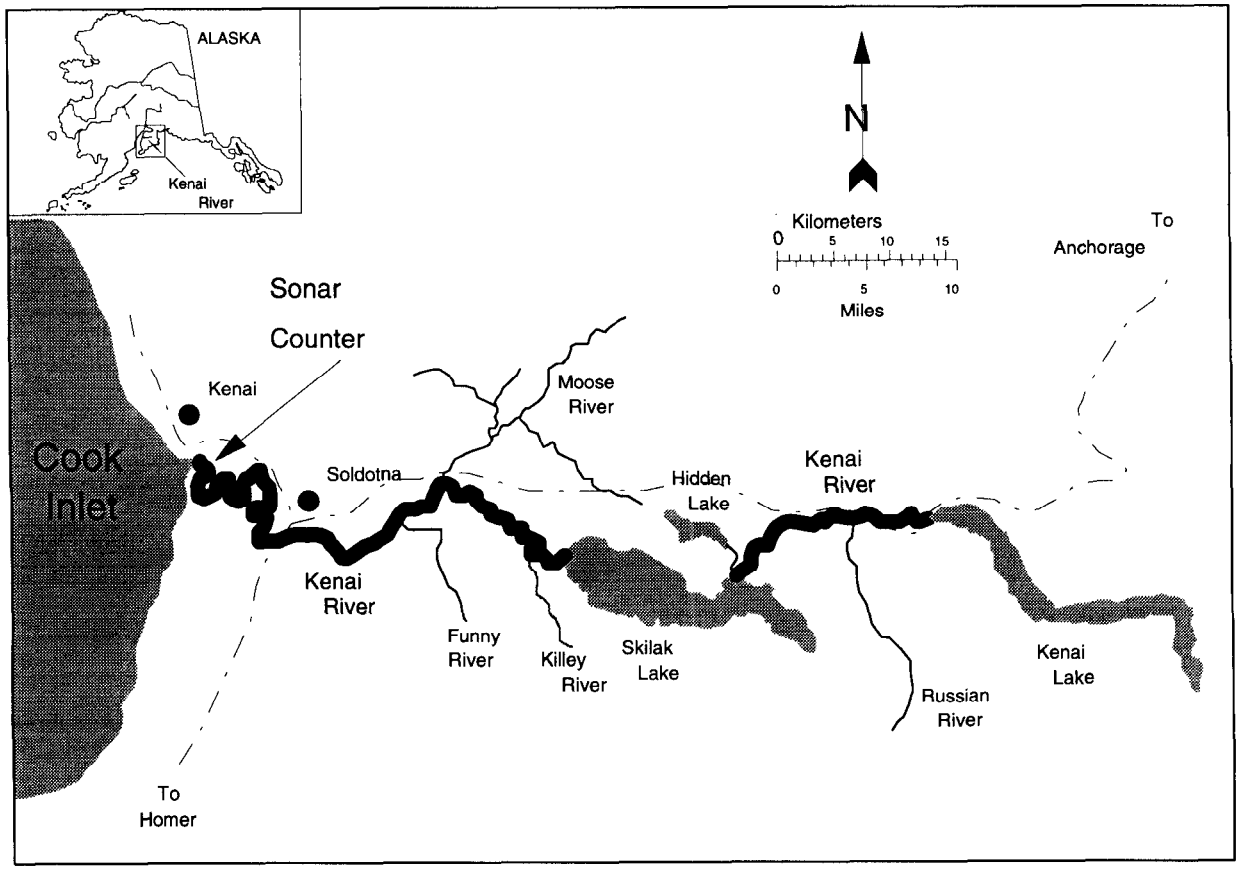

Figure 1.-Map of the Kenai River drainage.

As fisheries targeting both the early and late runs continued to grow during the early 1980s, concerns about overexploitation were heightened. In 1988, the Board of Fisheries (BOF) adopted management plans for the early and late returns of chinook salmon to the Kenai River (McBride et al. 1989). These plans, which have been in effect since 1989, stipulate both escapement goals for which the fisheries will be managed by the Alaska Department of Fish and Game (ADF&G), and the manner in which these fisheries are to be managed in the event of a conservation shortfall (Figure 3; Appendix A).

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

Since 1993, fishing from boats downstream from the outlet of Skilak Lake is prohibited on

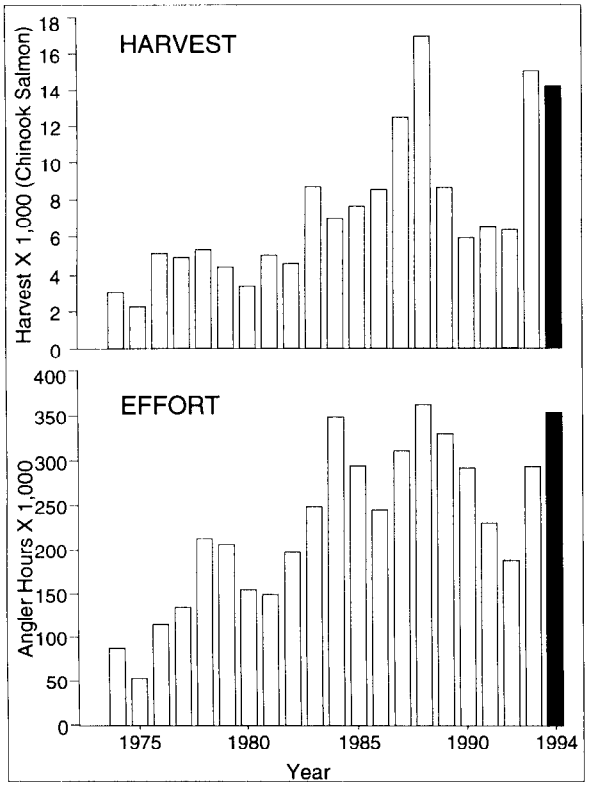

Figure 2.-Historical harvest and effort in the recreational fishery for late-run chinook salmon, Kenai River, 1974-1994.

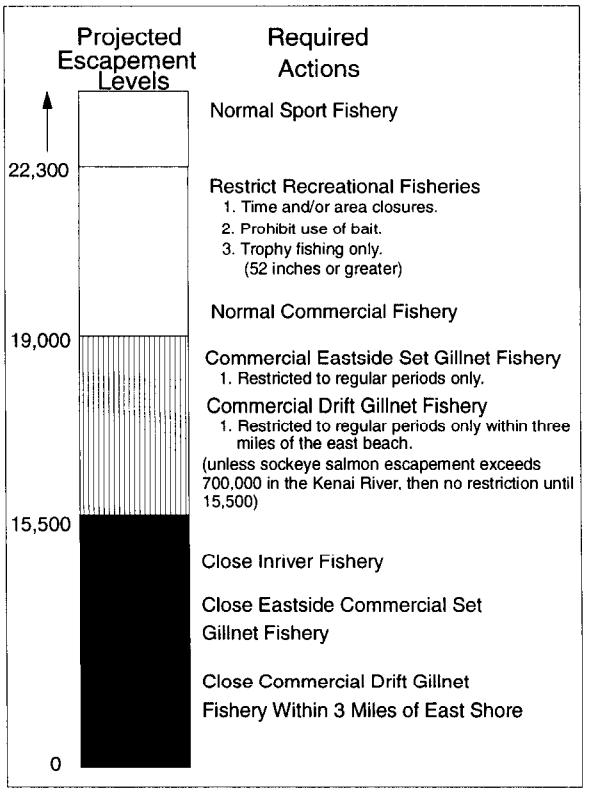

Figure 3.-Escapement levels and required actions according to the Kenai River Late King Salmon Management Plan.

Mondays in July. Anyone retaining a chinook salmon that is 41 cm in length or greater is prohibited from fishing from a boat in the Kenai River for the remainder of that day. Anglers employing guides are restricted further: during July, fishing from a guided boat is allowed only between 0600 and 1800 hours, and on Tuesday through Saturday only.

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

This report compiles statistics for the 1994 late run, including estimates of inriver return, fishery parameters, and escapement. The estimates are compared to historic data and their application to the 1994 return is discussed. Finally, a forecast of the 1995 return is presented.

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

Previous studies of the chinook salmon fisheries in the Kenai River include the following: Hammarstrom (1975-1981, 1988-1991, 1992a and b, 1993a and b, 1994a and b); Hammarstrom and Larson (1982-1984, 1986); Hammarstrom et al. (1985); Conrad and Hammarstrom (1987). Details of the 1994 creel survey of the recreational fishery are reported by King (*In prep*). In addition, angler effort and harvest by species for the recreational fishery have been estimated by Mills (1979-1994) via postal questionnaire. Rationale for the escapement goals and migratory timing data to implement the management plans are contained in McBride et al. (1989). Bendock and Alexandersdottir (1992) estimated hooking mortality for the Kenai River chinook salmon recreational fisheries. Estimates of total return by age were summarized through 1990 by Sonnichsen and Alexandersdottir (1991).

SUMMARY OF HISTORICAL DATA

HARVEST AND ESCAPEMENT

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

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

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

Inriver returns have been estimated annually since 1984. Two methods have been employed: a tag-recapture program from 1984-1990 (Hammarstrom and Larson 1986; Conrad and Larson 1987; Conrad 1988; Carlon and Alexandersdottir 1989; Alexandersdottir and Marsh 1990); and a hydroacoustic (sonar) program from 1984-1993 (Burwen and Skvorc *In prep* a, b, c, and d; and Burwen *In prep* a and b). Since 1987, sonar has provided the best estimate of the inriver return. The tag-recapture program was last conducted in 1990. Since 1984, the inriver return has averaged 41,547 fish.

To estimate abundance by age, the age/sex composition of the inriver return is estimated. Prior to 1991, scale samples collected from chinook salmon captured with large mesh gillnets during the tag-recapture studies provided the samples for this analysis. Although the tagging program was

discontinued in 1991, age, sex and length samples are still collected using gillnets.

The commercial set gillnet harvest in Cook Inlet is sampled for age, sex and size composition by the Commercial Fisheries Management and Development Division (CFMD) of ADF&G, as described by Waltemyer (*In prep*). These data provide estimates of the numbers of chinook salmon by age, sex and size in the commercial set gillnet, drift gillnet, and subsistence gillnet harvest. Age, sex, and size composition of the drift, subsistence and personal use gillnet harvest is assumed to be the same as the commercial set gillnet harvest.

The age, sex and size composition of the sport harvest is estimated from samples collected during angler interviews conducted in the creel survey (Hammarstrom 1994b).

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

Brood and Sibling Relationships

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

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

Migratory Timing

The following databases were used to estimate the annual migratory timing of the late run chinook salmon return to the Kenai River: (1) inriver return, measured by daily gillnet CPUE for 1984 to 1986 and by daily sonar counts for 1987 to 1993; and (2) inriver recreational fishery statistics including angler effort, harvest, and catch.

Historic cumulative daily proportions of each of these statistics were used to generate migratory timing models of each parameter that were applied to the current year's data to predict season-end values (McBride et al. 1989). Cumulative daily proportions of the inriver return for the years 1985-1993 were averaged to formulate the model (referred to as mean timing model) that projected total inriver return for 1994 (Appendix B1). Although other models have been evaluated (Hammarstrom 1994b), the mean timing

model has been the most consistent and was utilized in 1994.

Cumulative daily proportions of recreational effort, harvest, and catch for the years 1984-1993 were used to generate the model that projected harvest and catch for 1994 (Appendices B2-B7).

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

ASSESSMENT OF THE 1994 LATE RETURN OF CHINOOK SALMON TO THE KENAI RIVER

EFFORT AND HARVEST OF LATE-RUN CHINOOK SALMON

The harvest from the recreational marine fishery near Deep Creek was estimated by onsite creel survey commencing 16 May (McKinley *In prep*). All 1,869 (SE = 124) chinook salmon harvested after 24 June in this fishery were assumed to be of late-run Kenai River origin. No biological samples were collected from this fishery. Age/sex composition of the marine harvest was assumed equal to the age/sex composition of the total return.

The commercial harvest in the set gillnet fishery along the eastern shore of Cook Inlet was 15,885 chinook salmon. This is the largest harvest since 1987 and is approximately 30% greater than the 1984 to 1992 mean of 12,182. Harvest of chinook salmon in the drift gillnet fishery was 459 fish, well below the historical mean. A total of 13 chinook salmon was reported retained for personal use from the combined commercial set and drift gillnet harvest.

A total of 1,502 chinook salmon with readable scales was sampled from the commercial set gillnet harvest (Table 1). Most of the harvest was composed of age-1.4 fish (61.1%), followed by age-1.3 (14.6%), and -1.2 (12.5%) fish.

In 1994, a subsistence set gillnet fishery was authorized in Cook Inlet, particularly along the eastern shore north of the village of Ninilchik. Additionally, a subsistence dip net fishery was allowed in the downstream 9.3 km (5.0 miles) of the Kenai River. Conditions of these subsistence fisheries required that participants be Alaska residents and obtain a permit from the department. Harvest was recorded on the permit which had to be returned to the department by the end of the season. These fisheries were administered by CFMD. Only chinook salmon harvested from 1 July and later were considered of late-run Kenai River origin. Total reported late-run chinook salmon subsistence harvest was 391: 274 in the set net fishery and 117 in the dip net fishery.

The Kenaitze educational fishery reported one chinook salmon harvested after 1 July and the Ninilchik educational fishery caught no chinook salmon after 1 July.

The 1994 inriver recreational fishery for late-run chinook salmon started 1 July. Angler effort during the fishery for late-run chinook salmon was estimated at 354,778 angler-hours (SE = 9,773) (King *In prep*). The estimated harvest of 14,388 (SE = 637) was nearly two times greater than the 1974-1993 average but was 891 less than the 1993 harvest (Table 2). Catch was estimated to be 18,539 (SE = 770). Anglers employing professional guides accounted for 46% of the harvest and 31% of the effort.

A total of 404 fish with readable scales was sampled from the recreational harvest. Because there was a significant difference in

Table 1.-Estimates by age class of the number of Kenai River late-run chinook salmon harvested in the Upper Subdistrict commercial set and drift gillnet fisheries, personal use/subsistence fisheries, and educational fisheries, Upper Cook Inlet, 1994.

	Age Class									
	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	Total
1 July - 11 July										
Males										
Sample Size	26	28	28	2	127	0	16	6	1	234
Percent	6.6	7.1	7.1	0.5	32.2	0.0	4.1	1.5	0.3	59.4
SE Percent	1.3	1.3	1.3	0.4	2.4	0.0	1.0	0.6	0.3	2.5
Harvest	247	266	266	19	1,210	0	152	57	10	2,227
SE Harvest	47	49	49	13	88	0	37	23	10	93
Females										
Sample Size	1	44	13	0	91	1	6	4	0	160
Percent	0.3	11.2	3.3	0.0	23.1	0.3	1.5	1.0	0.0	40.6
SE Percent	0.3	1.6	0.9	0.0	2.1	0.3	0.6	0.5	0.0	2.5
Harvest	10	419	124	0	866	10	57	37	0	1,523
SE Harvest	10	60	34	0	80	10	23	19	0	93
Combined										
Sample Size	27	72	41	2	218	1	22	10	1	394
Percent	6.9	18.3	10.4	0.5	55.3	0.3	5.6	2.5	0.3	100.0
SE Percent	1.3	1.9	1.5	0.4	2.5	0.3	1.2	0.8	0.3	
Harvest	257	685	390	19	2,075	10	209	95	10	3,750
SE Harvest	48	73	58	13	94	10	43	30	10	
12 July - 24 July										
Males										
Sample Size	36	60	60	1	142	2	21	6	0	328
Percent	6.4	10.7	10.7	0.2	25.2	0.4	3.7	1.1	0.0	58.3
SE Percent	1.0	1.3	1.3	0.2	1.8	0.3	0.8	0.4	0.0	2.1
Harvest	339	565	565	9	1,337	19	198	56	0	3,087
SE Harvest	55	69	69	9	97	13	42	23	0	110
Females										
Sample Size	1	21	33	0	164	2	9	5	0	235
Percent	0.2	3.7	5.9	0.0	29.1	0.4	1.6	0.9	0.0	41.7
SE Percent	0.2	0.8	1.0	0.0	1.9	0.3	0.5	0.4	0.0	2.1
Harvest	9	198	311	0	1,544	19	85	47	0	2,212
SE Harvest	9	42	53	0	102	13	28	21	0	110
Combined										
Sample Size	37	81	93	1	306	4	30	11		563
Percent	6.6	14.4	16.5	0.2	54.4	0.7	5.3	2.0	0.0	100.0
SE Percent	1.0	1.5	1.6	0.2	2.1	0.4	0.9	0.6	0.0	
Harvest	348	762	875	9	2,880	38	282	104	0	5,299
SE Harvest	55	78	83	9	111	19	50	31	0	

-continued-

Table 1.-Page 2 of 2.

	Age Class									
	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	Total
25 July - 14 September										
Males										
Sample Size	0	41	40	0	178	1	18	3	0	281
Percent	0.0	7.5	7.3	0.0	32.7	0.2	3.3	0.6	0.0	51.6
SE Percent	0.0	1.1	1.1	0.0	2.0	0.2	0.8	0.3	0.0	2.1
Harvest	0	579	565	0	2,515	14	254	42	0	3,970
SE Harvest	0	87	86	0	155	14	59	24	0	165
Females										
Sample Size	0	5	43	1	196	1	16	2	0	264
Percent	0.0	0.9	7.9	0.2	36.0	0.2	2.9	0.4	0.0	48.4
SE Percent	0.0	0.4	1.2	0.2	2.1	0.2	0.7	0.3	0.0	2.1
Harvest	0	71	608	14	2,769	14	226	28	0	3,730
SE Harvest	0	31	89	14	158	14	56	20	0	165
Combined										
Sample Size	0	46	83	1	374	2	34	5	0	545
Percent	0.0	8.4	15.2	0.2	68.6	0.4	6.2	0.9	0.0	100.0
SE Percent	0.0	1.2	1.5	0.2	2.0	0.3	1.0	0.4	0.0	
Harvest	0	650	1,173	14	5,284	28	480	71	0	7,700
SE Harvest	0	92	119	14	153	20	80	31	0	
All Periods Combined										
Males										
Sample Size	62	129	128	3	447	3	55	15	1	843
Percent	3.5	8.4	8.3	0.2	30.2	0.2	3.6	0.9	0.1	55.4
SE Percent	1.6	2.2	2.2	0.4	3.6	0.3	1.5	0.8	0.3	3.9
Harvest	586	1,410	1,396	28	5,061	33	604	156	10	9,284
SE Harvest	72	121	121	16	203	19	82	41	10	219
Females										
Sample Size	2	70	89	1	451	4	31	11	0	659
Percent	0.1	4.1	6.2	0.1	30.9	0.3	2.2	0.7	0.0	44.6
SE Percent	0.3	1.8	1.8	0.2	3.5	0.4	1.1	0.7	0.0	3.9
Harvest	19	687	1,042	14	5,179	42	368	112	1	7,465
SE Harvest	13	80	109	14	204	22	67	35	0	219
Combined										
Sample Size	64	199	217	4	898	7	86	26	1	1,502
Percent	3.6	12.5	14.6	0.3	61.1	0.5	5.8	1.6	0.1	100.0
SE Percent	1.6	2.7	2.7	0.4	3.8	0.5	1.8	1.1	0.3	
Harvest	605	2,098	2,438	43	10,239	75	972	269	10	16,749
SE Harvest	73	141	156	22	211	29	104	53	10	

Table 2.-Summary of historical harvest, angler effort and harvest rate in the recreational fishery for late-run chinook salmon, Kenai River, 1974-1994.

	Harvest			Effort in Angler Hours			Harvest per Hour		
Year	Unguided	Guided	Total	Unguided	Guided	Total	Unguided	Guided	Total
1974			3,225			87,162			0.037
1975			2,355			53,523			0.044
1976			5,353			114,795			0.047
1977			5,148			135,082			0.038
1978			5,578			212,217			0.026
1979			4,634			205,887			0.023
1980			3,608			154,435			0.023
1981	2,755	2,530	5,285	112,569	36,727	149,296	0.024	0.069	0.035
1982	2,413	2,397	4,810	146,947	50,828	197,775	0.016	0.047	0.024
1983	4,064	5,110	9,174	197,324	51,195	248,519	0.021	0.100	0.037
1984	4,448	2,928	7,376	302,915	45,664	348,579	0.015	0.064	0.021
1985	5,010	3,045	8,055	248,517	45,936	294,453	0.020	0.066	0.027
1986	5,458	3,546	9,004	191,597	52,843	244,440	0.028	0.067	0.037
1987	6,361	5,966	12,327	231,511	79,329	310,840	0.027	0.075	0.040
1988	8,103	9,409	17,512	266,578	95,181	361,759	0.030	0.099	0.048
1989	3,799	5,328	9,127	231,085	97,966	329,051	0.016	0.054	0.028
1990 [a]	2,439	3,808	6,247	190,743	101,223	291,966	0.013	0.038	0.022
1991	2,985	3,864	6,849	147,293	82,706	229,999	0.020	0.047	0.030
1992 [a]	2,504	4,176	6,680	112,091	75,324	187,415	0.024	0.064	0.039
1993	7,413	7,866	15,279	201,695	92,213	293,908	0.037	0.085	0.052
Mean	4,442	4,613	7,381	198,528	69,780	222,555	0.023	0.067	0.034
1994	7,760	6,628	14,388	244,729	110,049	354,778	0.032	0.060	0.041

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

age composition between the first and second half of July (χ^2 = 9.68, df = 4, α = 0.05, P < 0.05), samples could not be combined. The majority of the harvest was age class 1.4 (90.5%) (Table 3), as has been the case historically (Table 4).

In 1994, an estimated 22% of the catch was released. Since 1986, the first year that estimates of total catch in the recreational fishery were available, an average of 26% of the catch has been released. In 1994, release mortality was estimated at 344 fish (SE = 144) (Table 5). The age and sex composition of the hook-and-release mortality was assumed equal to that of the inriver return (Table 6).

INRIVER RETURN

Counting of fish by sonar began 16 May and continued through the early and late runs (Burwen *In prep* b). Inriver return from 1 July through 7 August was 53,281 fish (Table 7; Figure 4). The 1994 inriver return was the second largest measured since 1984, and was 32% greater than the 1984-1993 mean of 40,375. Cumulative proportions by date for 1994 remained within the 1985-1993 95% confidence interval throughout the late run (Figure 5).

A total of 414 chinook salmon were captured in gillnet test fishing during the late run (Table 8). There was a significant difference in the age composition between the first half of the run and the second half (χ^2 = 25.65, df = 4, α = 0.05, P < 0.001). The inriver return was predominantly age 1.4 (78.3%) followed by age class 1.3, 1.2, and 1.5 (11.3%, 5.5%, 4.1%, respectively). Age-1.4 fish have historically dominated the total inriver return (Table 9).

ESCAPEMENT AND TOTAL RETURN

Spawning escapement by age class was estimated by subtracting total inriver fishing mortality from the inriver return. In 1994, an estimated 38,549 (SE = 653) chinook salmon escaped all fisheries (Table 10). The majority (73.8%) of these spawners were age class 1.4. This age class has been the predominant spawning age class since 1986.

The total return of late-run chinook salmon to the Kenai River is the sum of the commercial, recreational, personal use and subsistence harvests plus the escapement. The estimated total return of chinook salmon to the Kenai River in 1994 was 71,899 (Table 11).

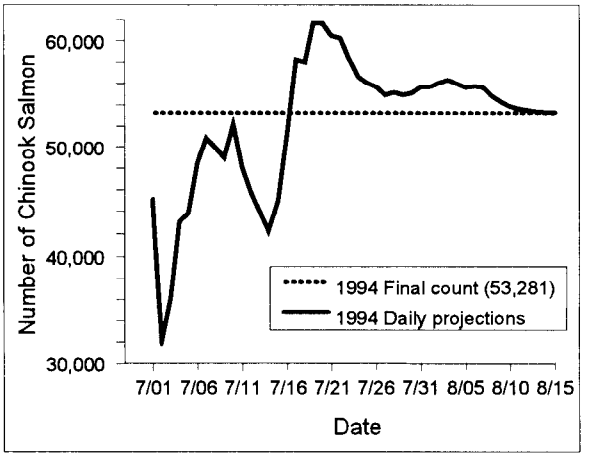

Figure 4.-Daily projections of total inriver return vs. the actual inriver return of late-run chinook salmon, Kenai River, 1994.

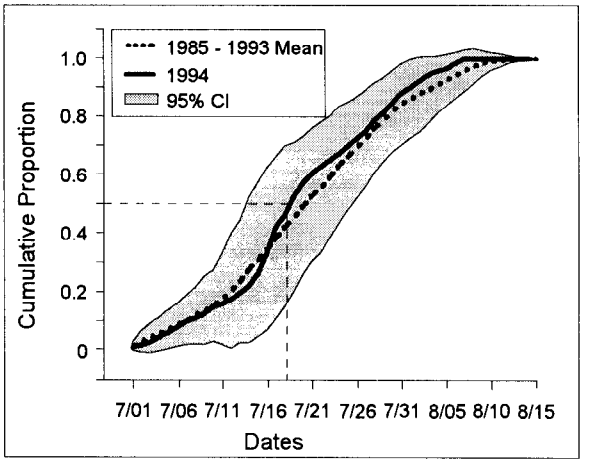

Figure 5.-Cumulative proportions by date for the inriver return of late-run chinook salmon to the Kenai River, 1985-1993 mean vs. 1994.

Table 3.-Estimates by age class of the number of late-run chinook salmon harvested in the recreational fishery on the Kenai River, 1994.

	Age Class					
	1.2	1.3	1.4	1.5	Other	Total
(7/01 - 7/15)						
Males						
Sample Size	7	9	72	1	1	90
Percent	3.8	4.9	39.1	0.5	0.5	48.9
SE Percent	1.4	1.6	3.6	0.5	0.5	3.7
Harvest	254	327	2,612	36	36	3,265
SE Harvest	94	106	241	36	36	247
Females						
Sample Size	1	2	88	3	0	94
Percent	0.5	1.1	47.8	1.6	0.0	51.1
SE Percent	0.5	0.8	3.7	0.9	0.0	3.7
Harvest	36	73	3,193	109	0	3,411
SE Harvest	36	51	247	62	0	247
Combined						
Sample Size	8	11	160	4	1	184
Percent	4.3	6.0	87.0	2.2	0.5	100.0
SE Percent	1.5	1.8	2.5	1.1	0.5	
Harvest	290	400	5,805	145	36	6,676
SE Harvest	101	117	166	72	36	
(7/16 - 8/07)						
Males						
Sample Size	1	6	76	3	0	86
Percent	0.5	2.7	34.5	1.4	0.0	39.1
SE Percent	0.5	1.1	3.2	0.8	0.0	3.3
Harvest	35	210	2,665	105	0	3,015
SE Harvest	35	85	248	60	0	254
Females						
Sample Size	0	2	130	2	0	134
Percent	0.0	0.9	59.1	0.9	0.0	60.9
SE Percent	0.0	0.6	3.3	0.6	0.0	3.3
Harvest	0	70	4,557	70	0	4,697
SE Harvest	0	49	256	49	0	254
Combined						
Sample Size	1	8	206	5	0	220
Percent	0.5	3.6	93.6	2.3	0.0	100.0
SE Percent	0.5	1.3	1.6	1.0	0.0	
Harvest	35	280	7,222	175	0	7,712
SE Harvest	35	98	127	78	0	
Late Run Total						
Males						
Percent	2.0	3.7	36.7	1.0	0.3	43.6
Harvest	289	537	5,277	141	36	6,280
SE Harvest	101	136	346	70	36	354
Females						
Percent	0.3	1.0	53.9	1.2	0.0	56.4
Harvest	36	143	7,750	179	0	8,108
SE Harvest	36	71	356	80	0	354
Combined						
Percent	2.3	4.7	90.5	2.2	0.3	100.0
Harvest	325	681	13,026	320	36	14,388
SE Harvest	107	152	209	106	36	

Table 4.-Estimates by age class of the number of late-run chinook salmon harvested in the recreational fishery on the Kenai River, 1976-1994.

	Age Class											
	1.1	1.2	1.3	1.4	1.5	1.6	2.2	2.3	2.4	2.5	Other	Total
1976												
Percent	10.7	27.0	18.3	40.1	3.6		0.3					100.0
Harvest	481	1,210	817	1,794	160		15					4,477
SE Harvest	79	114	99	125	48		15					
1977												
Percent		11.5	41.4	44.8	1.7				0.6			100.0
Harvest		592	2,130	2,307	89				30			5,148
SE Harvest		125	193	195	51				30			
1978												
Percent		12.6	8.0	77.7	1.7							100.0
Harvest		701	446	4,335	96							5,578
SE Harvest		68	73	89	0							
1979												
Percent		15.1	17.8	54.8	12.3							100.0
Harvest		698	825	2,540	571							4,634
SE Harvest		195	209	272	180							
1980												
Percent		21.2	21.5	49.8	7.5							100.0
Harvest		763	776	1,797	272							3,608
SE Harvest		88	89	108	57							
1981												
Percent		12.8	22.2	62.4	2.6							100.0
Harvest		678	1,174	3,297	136							5,285
SE Harvest		164	204	238	78							
1982												
Percent		11.8	26.0	58.8	1.7						1.7	100.0
Harvest		566	1,253	2,829	81						81	4,810
SE Harvest		143	194	218	57						57	
1983												
Percent		3.7	4.9	86.4	2.5				2.5			100.0
Harvest		340	453	7,927	227				227			9,174
SE Harvest		194	222	351	159				159			
1984												
Percent		8.8	16.0	62.5	12.7							100.0
Harvest		650	1,179	4,610	937							7,376
SE Harvest		95	122	162	111							
1985												
Percent		3.9	12.8	73.5	8.0						1.8	100.0
Harvest		315	1,031	5,923	646						140	8,055
SE Harvest		73	125	166	102						49	

-continued-

Table 4.-Page 2 of 2.

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

Table 5.-Estimates of the number of late-run chinook salmon mortalities attributable to hook-and-release fishing, Kenai River, 1986-1994.

Year	Sport Catch	Sport Harvest	Number Released	SE Released	Percent Mortality[a]	SE Percent	Hook-and-Release Mortality	SE Mortality
1986	15,331	9,004	6,327	872	8.3 (E)	3.39	522	220
1987	16,701	12,237	4,464	1,214	8.3 (E)	3.39	368	174
1988	23,238	17,512	5,726	1,590	8.3 (E)	3.39	472	225
1989	12,210	9,127	3,083	1,097	10.6 (M)	3.30	327	148
1990	8,637	6,247	2,390	709	5.9 (M)	3.30	141	65
1991	8,091	6,849	1,242	248	8.3 (E)	3.39	103	46
1992	10,394	6,680	3,714	409	8.3 (E)	3.39	308	130
1993	19,660	15,279	4,381	486	8.3 (E)	3.39	363	153
1994	18,539	14,388	4,151	432	8.3 (E)	3.39	344	144

[a] (E) Estimated as the mean of the 1989 and 1990 mortality ratios (Bendock and Alexandersdottir 1992).
(M) Measured.

Table 6.-Estimates by age class of the number of late-run chinook salmon that died as a result of hook-and-release fishing in the recreational fishery on the Kenai River, 1994.

	Age Class					
	1.2	1.3	1.4	1.5	Other	Total
Males						
Sample Size[a]	22	28	98	8	0	156
Percent	8.2	10.4	36.4	3.0	0.0	58.0
SE Percent	1.7	1.9	2.9	1.0	0.0	3.0
Mortality	28	36	125	10	0	199
SE Mortality	13	16	53	5	0	84
Females						
Sample Size[a]	0	12	93	5	3	113
Percent	0.0	4.5	34.6	1.9	1.1	42.0
SE Percent	0.0	1.3	2.9	0.8	0.6	3.0
Mortality	0	15	119	7	4	145
SE Mortality	0	8	51	4	3	61
Combined						
Sample Size[a]	22	40	191	13	3	269
Percent	8.2	14.9	71.0	4.8	1.1	100.0
SE Percent	1.7	2.2	2.8	1.3	0.6	
Mortality	28	51	244	17	4	344
SE Mortality	13	22	103	8	3	144

[a] Age/sex composition of released fish that died as a result of hook-and-release fishing was assumed equal to the age/sex composition of the inriver return during stratum 7/01-7/23.

Table 7.-Historical sonar counts of chinook salmon in the Kenai River during the late run, 1987-1994.

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

Table 8.-Estimates by age class of the number of late-run chinook salmon in the inriver return to the Kenai River, 1994.

	Age Class					
	1.2	1.3	1.4	1.5	2.4	Total
(7/01 - 7/23)						
Males						
Sample Size	22	28	98	8	0	156
Percent	8.2	10.4	36.4	3.0	0.0	58.0
SE Percent	1.7	1.9	2.9	1.0	0.0	3.0
Return	2,825	3,596	12,586	1,028	0	20,035
SE Return	578	644	1016	358	0	1,042
Females						
Sample Size	0	12	93	5	3	113
Percent	0.0	4.5	34.6	1.9	1.1	42.0
SE Percent	0.0	1.3	2.9	0.8	0.6	3.0
Return	0	1,541	11,944	642	385	14,512
SE Return	0	436	1004	285	222	1,042
Combined						
Sample Size	22	40	191	13	3	269
Percent	8.2	14.9	71.0	4.8	1.1	100.0
SE Percent	1.7	2.2	2.8	1.3	0.6	
Return	2,825	5,137	24,530	1,670	385	34,547
SE Return	578	751	958	453	222	
(7/24 - 8/15)						
Males						
Sample Size	1	5	49	1	0	56
Percent	0.7	3.4	33.8	0.7	0.0	38.6
SE Percent	0.7	1.5	3.9	0.7	0.0	4.1
Return	129	646	6,331	129	0	7,235
SE Return	129	285	738	129	0	760
Females						
Sample Size	0	2	84	3	0	89
Percent	0.0	1.4	57.9	2.1	0.0	61.4
SE Percent	0.0	1.0	4.1	1.2	0.0	4.1
Return	0	258	10,853	388	0	11,499
SE Return	0	182	771	222	0	760
Combined						
Sample Size	1	7	133	4	0	145
Percent	0.7	4.8	91.7	2.8	0.0	100.0
SE Percent	0.7	1.8	2.3	1.4	0.0	
Return	129	904	17,184	517	0	18,734
SE Return	129	335	430	256	0	
Late Run Total						
Males						
Percent	5.5	8.0	35.5	2.2	0.0	51.2
Return	2,954	4,242	18,917	1,158	0	27,270
SE Return	593	705	1,256	381	0	1,289
Females						
Percent	0.0	3.4	42.8	1.9	0.7	48.8
Return	0	1,799	22,797	1,030	385	26,011
SE Return	0	472	1,265	361	222	1,289
Combined						
Percent	5.5	11.3	78.3	4.1	0.7	100.0
Return	2,954	6,041	41,714	2,187	385	53,281
SE Return	593	822	1,050	520	222	

Table 9.-Estimates by age class of the number of late-run chinook salmon in the total return to the Kenai River, 1986-1994.

	Age Class														
	0.2	0.3	0.4	0.5	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	Total
1986															
Percent	0.1	0.1	0.0	0.0	0.3	15.1	44.2	36.4	3.5	0.0	0.1	0.1	0.2	0.1	100.0
Return	43	43	22	22	260	12,017	35,314	29,039	2,774	22	43	43	152	43	79,837
SE Return	24	24	17	17	60	3,436	9,106	6,482	776	17	24	24	46	24	19,458
1987															
Percent	0	0	0	0	0.5	4.9	30.2	63.0	1.0	0.1	0.1	0.1	0.1	0.1	100.0
Return	0	0	0	0	361	3,635	22,427	46,812	775	99	51	44	97	58	74,359
SE Return					75	315	796	823	173	70	51	23	57	50	0
1988															
Percent	0	0	0.1	0	0.7	3.3	6.0	75.0	14.8	0	0	0.1	0.0	0.1	100.0
Return	0	0	35	0	454	2,235	4,116	51,233	10,121	0	0	46	15	101	68,356
SE Return			17		72	241	375	820	735			23	13	36	0
1989															
Percent	0	0	0	0	0.3	12.2	15.0	60.3	11.8	0.2	0.0	0.1	0	0.0	100.0
Return	0	0	0	0	108	5,053	6,194	24,908	4,888	76	0	34	0	13	41,274
SE Return					38	438	468	662	456	69		24		13	0
1990															
Percent	0	0.0	0.0	0	0.2	14.5	16.6	63.6	4.6	0	0.1	0.1	0.1	0.2	100.0
Return	0	11	11	0	65	5,749	6,572	25,237	1,841	0	45	23	23	79	39,656
SE Return		10	10		22	480	519	655	307		19	14	14	26	0
1991															
Percent	0.0	0	0.1	0	0.1	10.3	18.5	64.4	5.8	0	0.0	0	0.6	0.0	100.0
Return	15	0	31	0	46	4,291	7,687	26,732	2,396	0	15	0	261	15	41,489
SE Return	15		22		27	526	721	903	479		15		154	15	0
1992															
Percent	0	0	0	0	0.8	9.7	19.7	66.5	2.8	0	0	0.2	0.3	0.0	100.0
Return	0	0	0	0	347	4,311	8,746	29,515	1,230	0	0	82	123	19	44,373
SE Return					83	468	649	766	267			41	50	19	0
1993															
Percent	0	0	0	0	0.8	9.4	15.9	68.0	5.3	0	0	0.0	0.6	0.1	100.0
Return	0	0	0	0	528	6,367	10,770	46,188	3,570	0	0	19	406	79	67,927
SE Return					99	739	950	1,215	624			19	207	39	0
1994															
Percent	0	0	0	0	0.9	7.2	12.1	74.2	4.5	0	0	0.1	0.1	0.9	100.0
Return	0	0	0	0	621	5,187	8,705	53,341	3,243	10	0	44	77	671	71,899
SE Return					73	610	837	1,071	530	10	0	22	29	389	0

Table 10.-Estimates by age class of the number of late-run chinook salmon in the spawning escapement to the Kenai River, 1986-1994.

	Age Class									
	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.3	2.4	Total
1986										
Inriver Return	0	7,009	27,141	21,413	2,000	0	0	0	0	57,563
SE Return	0	3,428	9,101	6,474	769	0	0	0	0	19,457
Harvest	37	913	3,507	4,072	475	0	0	0	0	9,004
SE Harvest	26	131	266	289	94	0	0	0	0	458
H&R[a] Mortality	0	63	229	207	23	0	0	0	0	522
SE H&R	0	27	96	87	10	0	0	0	0	220
Escapement[b]	0	6,033	23,405	17,134	1,502	0	0	0	0	48,037
SE Escapement	0	3,425	9,097	6,467	763	0	0	0	0	19,450
1987										
Inriver Return	0	898	13,407	33,119	500	99	50	0	50	48,123
SE Return	0	209	696	719	157	70	50	0	50	0
Harvest	51	127	2,787	8,892	380	0	0	0	0	12,237
SE Harvest	36	57	292	611	99	0	0	0	0	769
H&R[a] Mortality	0	7	103	253	4	1	0	0	0	368
SE H&R	0	4	49	120	2	1	0	0	0	174
Escapement[b]	0	764	10,517	23,974	116	98	50	0	50	35,518
SE Escapement	0	201	630	359	122	70	50	0	50	788
1988										
Inriver Return	0	628	1,888	39,860	9,632	0	0	0	0	52,008
SE Return	0	198	340	793	732	0	0	0	0	0
Harvest	126	42	589	13,766	2,989	0	0	0	0	17,512
SE Harvest	73	42	159	887	368	0	0	0	0	1,036
H&R[a] Mortality	0	6	18	367	81	0	0	0	0	472
SE H&R	0	3	9	175	39	0	0	0	0	225
Escapement[b]	0	580	1,281	25,727	6,562	0	0	0	0	34,024
SE Escapement	0	193	300	434	632	0	0	0	0	1,060
1989										
Inriver Return	8	3,129	3,734	18,366	3,722	76	0	0	0	29,035
SE Return	8	409	437	629	440	69	0	0	0	0
Harvest	0	90	994	6,507	1,446	0	0	0	90	9,127
SE Harvest	0	90	291	585	345	0	0	0	90	582
H&R[a] Mortality	1	34	40	211	40	1	0	0	0	327
SE H&R	1	16	19	96	18	1	0	0	0	148
Escapement[b]	7	3,005	2,700	11,648	2,236	75	0	0	0	19,581
SE Escapement	8	399	325	210	272	69	0	0	0	601

-continued-

Table 10.-Page 2 of 2.

	Age Class									
	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.3	2.4	Total
1990										
Inriver Return	0	4,204	4,934	22,808	1,528	0	0	0	0	33,474
SE Return	0	471	510	647	304	0	0	0	0	0
Harvest	37	605	989	3,883	733	0	0	0	0	6,247
SE Harvest	26	109	142	322	121	0	0	0	0	445
H&R[a] Mortality	0	17	21	97	6	0	0	0	0	141
SE H&R	0	8	10	45	3	0	0	0	0	65
Escapement[b]	0	3,582	3,924	18,828	789	0	0	0	0	27,086
SE Escapement	0	458	490	559	279	0	0	0	0	450
1991										
Inriver Return	0	2,580	5,482	24,080	2,257	0	0	215	0	34,614
SE Return	0	507	705	889	477	0	0	152	0	0
Harvest	0	338	799	5,221	430	0	0	61	0	6,849
SE Harvest	0	101	155	369	114	0	0	43	0	410
H&R[a] Mortality	0	8	16	71	7	0	0	1	0	103
SE H&R	0	4	8	32	3	0	0	0	0	46
Escapement[b]	0	2,234	4,667	18,788	1,820	0	0	153	0	27,662
SE Escapement	0	497	688	808	463	0	0	146	0	413
1992										
Inriver Return	0	2,206	4,863	22,546	699	0	0	0	0	30,314
SE Return	0	427	603	718	247	0	0	0	0	0
Harvest	33	133	1,030	5,085	399	0	0	0	0	6,680
SE Harvest	33	66	185	405	115	0	0	0	0	462
H&R[a] Mortality	0	21	49	231	7	0	0	0	0	308
SE H&R	0	10	21	98	4	0	0	0	0	130
Escapement[b]	0	2,052	3,784	17,230	293	0	0	0	0	23,326
SE Escapement	0	422	574	585	219	0	0	0	0	480
1993										
Inriver Return	0	4,012	6,985	35,565	2,825	0	0	287	0	49,674
SE Return	0	712	919	1,180	613	0	0	202	0	0
Harvest	0	288	865	13,084	887	0	89	44	22	15,279
SE Harvest	0	80	139	569	141	0	44	31	22	620
H&R[a] Mortality	0	45	64	236	15	0	2	1	0	363
SE H&R	0	21	28	100	8	0	2	1	0	153
Escapement[b]	0	3,679	6,056	22,245	1,923	0	0	242	0	34,032
SE Escapement	0	707	908	1,029	597	0	0	200	0	639
1994										
Inriver Return	0	2,954	6,041	41,714	2,187	0	0	0	385	53,281
SE Return	0	593	822	1,050	520	0	0	0	222	0
Harvest	36	325	681	13,026	320	0	0	0	0	14,388
SE Harvest	36	107	152	209	106	0	0	0	0	637
H&R[a] Mortality	0	28	51	244	17	0	0	0	4	344
SE H&R	0	13	22	103	8	0	0	0	3	144
Escapement[b]	0	2,601	5,309	28,444	1,850	0	0	0	381	38,549
SE Escapement	0	583	808	1,024	509	0	0	0	222	653

[a] Hook-and-Release.

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

Table 11.-Summary of late-run Kenai River chinook salmon population data, 1984-1994.

Year	Deep Creek Marine Harvest	Eastside Set Net Harvest	Drift Gillnet Harvest	Commercial Personal Use	Subsistence[a]	Kenai River Inriver Return	Total Return	Sport Harvest	Hook-and-Release Mortality	Escape-ment
1984	835	6,165	1,377			39,172	47,549	7,376	Unknown	31,796
1985	1,731	17,723	2,046			29,763	51,263	8,055	Unknown	21,708
1986	630	19,810	1,834			57,563	79,837	9,004	522	48,037
1987	1,097	20,588	4,551			48,123	74,359	12,237	368	35,518
1988	1,262	12,870	2,216			52,008	68,356	17,512	472	34,024
1989	1,294	10,919	0 [b]	4	22	29,035	41,274	9,127	327	19,581
1990	1,318	4,139	621	91	13	33,474	39,656	6,247	141	27,086
1991	1,325	4,891	241	130	288	34,614	41,489	6,849	103	27,662
1992	2,346	10,718	543	50	402 [c]	30,314	44,373	6,680	308	23,326
1993	3,344	14,002	751	129	27 [d]	49,674	67,927	15,279	363	34,032
1994[e]	1,869	15,885	459	13	392 [f]	53,281	71,899	14,388	344	38,549

[a] Includes harvest in Kenaitze educational gillnet fishery.

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

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

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

[e] Preliminary data.

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

BROOD RELATIONSHIPS

Age components of measured returns are presented in Table 12 and a summary of the production from each brood year appears in Table 13. Total production from the first measured escapement (31,796 fish in 1984) barely exceeded replacement. Production from the 1985 escapement (21,708) was nearly a two-fold return. However, production from the largest measured escapement of 48,037 in 1986 appears only able to replace itself. Production from the 1987 escapement (35,318) was nearly that of 1985 at a 1.79 return-per-spawner ratio. Production from the 1988 escapement (34,024) has already exceeded a two-fold return with age-7 (1.5) fish to return in 1995.

SIBLING RELATIONSHIPS

Sibling return ratios (Sonnichsen and Alexandersdottir 1991) have been used to forecast returns since 1990 (Table 14). Observed returns have ranged from 4.6% less than the forecasted value to 30% greater than the forecasted value, averaging 11% greater than the anticipated return (Table 15). The 1995 forecast for late-run chinook salmon to the Kenai River is 74,615 (Table 15).

MIGRATORY TIMING MODELS

The mean timing model used to predict the inriver return performed well again in 1994 (Figures 4 and 5). Although the same three other models evaluated in 1993 (Hammarstrom 1994a) were maintained in 1994, they performed poorly. The mean timing model was the basis for the liberalization of the recreational fishery into August. However, it should be noted that the neap-tide model again accurately predicted the date of peak passage across the sonar counter.

The two models used to predict end of season (31 July) harvest and catch also performed well. Beginning approximately 10 July, the daily projections of end of season harvest and catch remained very close to the realized harvest and catch (Figure 6.) As a result, combining the three models, inriver return, harvest, and catch, to predict the final escapement remained within ±25% throughout the fishery (Figure 7).

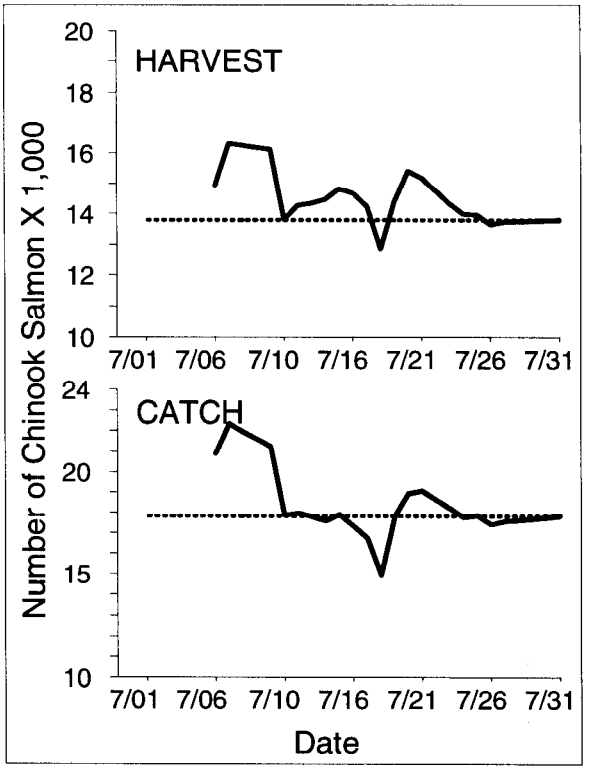

Figure 6.-Daily projections of seasonal (1 July-31 July) harvest and catch (solid lines) vs. realized harvest and catch (dotted lines) of late-run chinook salmon by the recreational fishery, Kenai River, 1994.

DISCUSSION

Timely estimates of the harvest and inriver return allow for the more precise management that is required by the management plan. The ability to obtain real-time estimates of inriver return provides the basis for the department to react to changing situations on relatively short notice. During 1994, the fishery was liberalized by adding an additional day of fishing in July and 7 days in August based on projections of escapement.

Table 12.-Age components of total returns of Kenai River late-run chinook salmon, 1986-1994.

Year	(0.2, 1.1) Age 3	(0.3, 1.2, 2.1) Age 4	(0.4, 1.3, 2.2) Age 5	(0.5, 1.4, 2.3) Age 6	(1.5, 2.4) Age 7	(1.6, 2.5) Age 8	Total Return
1986	303	12,103	35,379	29,213	2,817	22	79,837
1987	361	3,686	22,471	46,909	833	99	74,359
1988	454	2,235	4,197	51,249	10,221		68,356
1989	108	5,053	6,228	24,908	4,901	76	41,274
1990	65	5,805	6,606	25,260	1,920		39,656
1991	61	4,306	7,718	26,993	2,411		41,489
1992	347	4,311	8,828	29,638	1,249		44,373
1993	528	6,367	10,789	46,594	3,649		67,927
1994	621	5,187	8,749	53,418	3,914	10	71,899

Table 13.-Summary of returns from each brood year, late-run Kenai River chinook salmon, 1978-1994.

Year	Spawning Escapement	Return (0.2,1.1) Age 3	(0.3,1.2,2.1) Age 4	(0.4,1.3,2.2) Age 5	(0.5,1.4,2.3) Age 6	(1.5,2.4) Age 7	(1.6,2.5) Age 8	Total Return To Date	Return Per Spawner
1978	Unknown						(1986) 22	22	
1979	Unknown					(1986) 2,817	(1987) 99	2,916	
1980	Unknown				(1986) 29,213	(1987) 833		30,046	
1981	Unknown			(1986) 35,379	(1987) 46,909	(1988) 10,222	(1989) 76	92,586	
1982	Unknown		(1986) 12,103	(1987) 22,471	(1988) 51,248	(1989) 4,901		90,723	
1983	Unknown	(1986) 303	(1987) 3,686	(1988) 4,197	(1989) 24,908	(1990) 1,920		35,014	
1984	31,796	(1987) 361	(1988) 2,235	(1989) 6,228	(1990) 25,260	(1991) 2,411		36,495	1.15
1985	21,708	(1988) 454	(1989) 5,053	(1990) 6,606	(1991) 26,993	(1992) 1,249		40,355	1.86
1986	48,037	(1989) 108	(1990) 5,805	(1991) 7,718	(1992) 29,638	(1993) 3,649	(1994) 10	46,928	0.98
1987	35,518	(1990) 65	(1991) 4,306	(1992) 8,828	(1993) 46,594	(1994) 3,914		63,707	1.79
1988	34,024	(1991) 61	(1992) 4,311	(1993) 10,789	(1994) 53,418			68,579	2.02
1989	19,581	(1992) 347	(1993) 6,367	(1994) 8,749				15,463	0.79
1990	27,086	(1993) 528	(1994) 5,187					5,715	
1991	27,662	(1994) 621							
1992	23,326								
1993	34,032								
1994	38,459								

Table 14.-Sibling return ratios for late-run Kenai River chinook salmon from brood years 1980-1990.

Brood Year	Age 4/ Age 3	Age 5/ Age 4	Age 6/ Age 5	Age 6/ Age 4+5	Age 7/ Age 6	Age 7/ Age 5+6	Age 7/ Age 4+5+6
1980					0.03		
1981			1.33		0.22	0.12	
1982		1.86	2.28	1.48	0.10	0.07	0.06
1983	12.17	1.14	5.93	3.16	0.08	0.07	0.06
1984	6.19	2.79	4.06	2.98	0.10	0.08	0.07
1985	11.13	1.31	4.09	2.32	0.05	0.04	0.03
1986	53.75	1.33	3.84	2.19	0.12	0.10	0.08
1987	66.25	2.05	5.28	3.55	0.08	0.07	0.07
1988	70.67	2.50	4.95	3.54			
1989	18.35	1.37					
1990	9.82						
Mean	31.04	1.79	3.97	2.75	0.10	0.08	0.06
SD	27.53	0.61	1.53	0.77	0.06	0.03	0.02
% Co Var[a]	89	34	39	28	60	35	28
Maximum	70.67	2.79	5.93	3.55	0.22	0.12	0.08
Minimum	6.19	1.14	1.33	1.48	0.03	0.04	0.03

[a] % Coefficient of variation

Table 15.-Summary of expected returns based on sibling return ratios versus observed returns for late-run Kenai River chinook salmon, 1990-1994, and 1995 projections.

	Return					
	Age 3	Age 4	Age 5	Age 6	Age 7	Total
1990						
Expected	306	1,061	9,736	19,639	2,775	33,517
Observed	65	5,806	6,606	25,259	1,920	39,656
Difference	(241)	4,745	(3,130)	5,620	(855)	6,139
Obs. as % of Exp.	21.2	547.2	67.9	128.6	69.2	118.3
1991						
Expected	258	1,353	10,289	29,637	1,950	43,487
Observed	61	4,306	7,718	26,993	2,411	41,489
Difference	(197)	2,953	(2,571)	(2,644)	461	(1,998)
Obs. as % of Exp.	23.6	318.3	75.0	91.1	123.6	95.4
1992						
Expected	223	1,328	6,634	32,397	2,367	42,949
Observed	347	4,311	8,828	29,638	1,249	44,373
Difference	124	2,983	2,194	(2,759)	(1,118)	1,424
Obs. as % of Exp.	155.6	324.6	133.1	91.5	52.8	103.3
1993						
Projected	234	10,327	6,808	30,048	2,279	49,696
Observed	440	5,951	10,113	44,586	3,493	64,583
Difference	206	(4,376)	3,305	14,538	1,214	14,887
Obs. as % of Exp.	188.0	57.6	148.5	148.4	153.3	130.0
1994						
Projected	267	14,916	10,894	37,331	3,468	66,876
Observed	621	5,187	8,749	53,418	3,914	71,899 [a]
Difference	354	(9,729)	(2,145)	16,087	446	5,023
Obs. as % of Exp.	232.6	34.8	80.3	143.1	112.9	107.5
1995						
Projected	316	19,276	9,301	41,502	4,220	74,615
Standard Error	68	20,103	3,682	12,429	1,419	23,963

[a] Includes 10 age-8 fish.

Analysis of four run timing models to predict the inriver return was completed in 1993 (Hammarstrom 1994a) and the mean timing model was selected as the model of choice. This model performed well again in 1994 and should continue to be the model used in 1995.

The results of the sibling model to predict future returns have been encouraging and evaluation should continue. Therefore, I recommend that the sibling model be used for 1995.

Preseason forecasts for late-run chinook salmon to the Kenai River have been reported beginning with the 1990 return. The projected returns for the years 1990-1994 have ranged from 33,517 to 66,876. The realized returns have ranged from 39,656 to 71,899. Forecasts have been less than the observed returns for all but one year. Observed returns have ranged from 95.5% to 130.0% of the expected return with the 1992 forecast being the closest to the realized return (103.3%). Although the fishery is managed based on the inseason return, the forecasts have been beneficial in preparing the fishing public, in a general sense, for the type of fishery to expect. Escapement objectives have been achieved each year since 1990. Restrictions to the recreational fishery were employed in 1990 and again in 1992. The commercial fishery was restricted in 1992. The recreational fishery was liberalized in 1991, 1993 and 1994. The anticipated return of nearly 75,000 chinook salmon in 1995 would allow for a harvest of approximately 50,000 fish by all fisheries. Should the forecast be realized and normal timing occur, some liberalization to the recreational fishery is probable and no inseason restrictions to the commercial fishery based on conservation concerns for chinook salmon should be required.

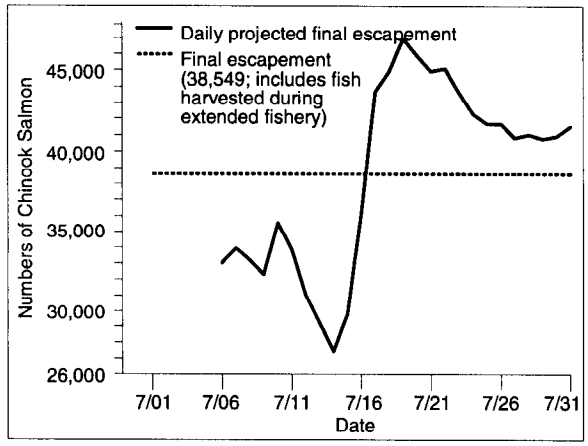

Figure 7.-Daily projections of final escapement of chinook salmon through the recreational fishery for late-run chinook salmon, Kenai River, 1994.

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APPENDIX A. KENAI RIVER LATE KING SALMON MANAGEMENT PLAN

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

5 AAC 21.359 KENAI RIVER LATE KING SALMON MANAGEMENT PLAN

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

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

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

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

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

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

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

(A) time or area is reduced;

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

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

(C) only artificial lures may be used.

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

(3) if the projected spawning escapement of chinook salmon is between 15,500 and 19,900, the department shall restrict the commercial fisheries as follows;

(A) within three miles of the Kenai Peninsula shoreline, the department shall limit the drift gill net fishery to regular periods;

(B) the department shall limit the set gill net fishery in the Upper Subdistrict of the Central District to regular periods;

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

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

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

Effective 1989, modified 1991.

APPENDIX B. SUPPORTING STATISTICS

Appendix B1.-Historical daily cumulative proportions of the inriver return of late-run chinook salmon to the Kenai River, 1985-1994.

	Daily cumulative proportions [P(t)] by year of inriver return												95% Confidence Interval		Rel[a]
Date	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Mean	SE	Low	High	Prec
7/01	0.025	0.014	0.012	0.012	0.036	0.016	0.008	0.012	0.011	0.012	0.016	0.003	0.010	0.022	37.7%
7/02	0.049	0.070	0.028	0.031	0.072	0.025	0.016	0.022	0.020	0.019	0.035	0.007	0.020	0.050	42.6%
7/03	0.080	0.095	0.040	0.063	0.088	0.038	0.026	0.032	0.026	0.031	0.052	0.009	0.032	0.071	37.3%
7/04	0.099	0.111	0.040	0.076	0.120	0.050	0.041	0.039	0.034	0.047	0.066	0.010	0.041	0.089	35.9%
7/05	0.120	0.116	0.067	0.101	0.158	0.075	0.050	0.046	0.043	0.060	0.083	0.012	0.055	0.111	32.9%
7/06	0.138	0.122	0.086	0.117	0.198	0.096	0.057	0.057	0.061	0.080	0.101	0.014	0.068	0.133	31.3%
7/07	0.170	0.127	0.104	0.148	0.235	0.117	0.062	0.065	0.092	0.100	0.122	0.016	0.083	0.159	30.4%
7/08	0.190	0.131	0.117	0.176	0.267	0.129	0.066	0.071	0.130	0.112	0.139	0.019	0.094	0.181	30.6%
7/09	0.206	0.142	0.127	0.210	0.326	0.139	0.077	0.078	0.167	0.126	0.160	0.023	0.105	0.212	32.9%
7/10	0.232	0.154	0.139	0.243	0.386	0.150	0.091	0.085	0.184	0.150	0.181	0.028	0.115	0.245	34.8%
7/11	0.264	0.166	0.150	0.265	0.435	0.171	0.103	0.090	0.209	0.159	0.201	0.032	0.126	0.273	35.8%
7/12	0.292	0.181	0.163	0.301	0.498	0.188	0.112	0.124	0.222	0.175	0.226	0.036	0.140	0.307	36.2%
7/13	0.325	0.219	0.185	0.337	0.531	0.223	0.121	0.144	0.290	0.195	0.257	0.038	0.167	0.343	33.4%
7/14	0.376	0.250	0.204	0.362	0.603	0.267	0.138	0.166	0.354	0.220	0.294	0.043	0.192	0.391	33.2%
7/15	0.414	0.283	0.220	0.395	0.631	0.301	0.153	0.191	0.399	0.261	0.325	0.044	0.220	0.425	30.9%
7/16	0.458	0.333	0.249	0.446	0.662	0.332	0.183	0.214	0.445	0.333	0.366	0.045	0.259	0.468	27.9%
7/17	0.485	0.377	0.298	0.474	0.694	0.405	0.241	0.233	0.486	0.421	0.411	0.043	0.309	0.510	23.9%
7/18	0.495	0.397	0.328	0.498	0.727	0.469	0.331	0.261	0.515	0.462	0.448	0.041	0.351	0.542	20.8%
7/19	0.510	0.421	0.355	0.534	0.743	0.510	0.390	0.298	0.530	0.527	0.482	0.039	0.389	0.571	18.4%
7/20	0.523	0.441	0.386	0.555	0.766	0.556	0.433	0.336	0.557	0.571	0.512	0.038	0.422	0.599	16.9%
7/21	0.565	0.466	0.429	0.583	0.793	0.580	0.464	0.362	0.577	0.603	0.542	0.038	0.453	0.628	15.8%
7/22	0.596	0.490	0.469	0.620	0.811	0.596	0.494	0.383	0.600	0.629	0.569	0.037	0.481	0.653	14.8%
7/23	0.627	0.527	0.499	0.649	0.835	0.616	0.571	0.431	0.624	0.648	0.603	0.034	0.521	0.680	12.9%
7/24	0.656	0.589	0.533	0.673	0.847	0.650	0.635	0.454	0.651	0.672	0.636	0.032	0.560	0.709	11.5%
7/25	0.692	0.603	0.578	0.696	0.864	0.675	0.672	0.511	0.696	0.698	0.668	0.030	0.599	0.735	10.0%
7/26	0.723	0.629	0.616	0.717	0.883	0.695	0.708	0.553	0.724	0.724	0.697	0.028	0.632	0.760	9.0%
7/27	0.767	0.654	0.648	0.739	0.899	0.718	0.742	0.605	0.764	0.747	0.728	0.026	0.667	0.787	8.0%
7/28	0.808	0.678	0.686	0.756	0.911	0.737	0.797	0.669	0.802	0.788	0.763	0.024	0.708	0.817	7.0%
7/29	0.825	0.700	0.711	0.769	0.924	0.754	0.830	0.720	0.830	0.813	0.787	0.022	0.735	0.837	6.3%
7/30	0.865	0.728	0.751	0.783	0.937	0.766	0.852	0.759	0.862	0.846	0.815	0.021	0.765	0.863	5.9%
7/31	0.885	0.754	0.801	0.814	0.948	0.776	0.880	0.791	0.880	0.880	0.841	0.020	0.795	0.885	5.3%
8/01	0.909	0.778	0.841	0.850	0.966	0.788	0.906	0.821	0.895	0.900	0.865	0.019	0.821	0.908	4.9%
8/02	0.920	0.799	0.841	0.887	0.973	0.800	0.930	0.855	0.908	0.923	0.883	0.018	0.840	0.925	4.7%
8/03	0.929	0.829	0.864	0.917	0.977	0.816	0.941	0.882	0.914	0.943	0.901	0.017	0.862	0.939	4.1%
8/04	0.939	0.855	0.891	0.941	0.986	0.838	0.950	0.911	0.924	0.955	0.919	0.015	0.884	0.952	3.6%
8/05	0.952	0.874	0.913	0.968	0.986	0.860	0.955	0.939	0.938	0.965	0.935	0.013	0.904	0.964	3.1%
8/06	0.962	0.895	0.924	0.987	0.986	0.877	0.965	0.961	0.960	0.985	0.950	0.012	0.921	0.978	2.9%
8/07	0.984	0.917	0.945	1.000	1.000	0.893	0.983	0.979	0.973	1.000	0.967	0.012	0.940	0.994	2.8%
8/08	0.997	0.935	0.965	1.000	1.000	0.915	1.000	0.986	0.986	1.000	0.979	0.010	0.956	1.000	2.2%
8/09	1.000	0.956	0.977	1.000	1.000	0.936	1.000	0.992	0.995	1.000	0.986	0.007	0.969	1.002	1.6%
8/10	1.000	0.968	0.989	1.000	1.000	0.957	1.000	1.000	1.000	1.000	0.991	0.005	0.980	1.003	1.1%
8/11	1.000	0.975	1.000	1.000	1.000	0.974	1.000	1.000	1.000	1.000	0.995	0.003	0.987	1.003	0.8%
8/12	1.000	0.984	1.000	1.000	1.000	0.985	1.000	1.000	1.000	1.000	0.997	0.002	0.992	1.002	0.5%
8/13	1.000	0.992	1.000	1.000	1.000	0.992	1.000	1.000	1.000	1.000	0.998	0.001	0.996	1.001	0.2%
8/14	1.000	1.000	1.000	1.000	1.000	0.996	1.000	1.000	1.000	1.000	1.000	0.000	0.999	1.001	0.1%
8/15	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%

[a] Relative precision.

Appendix B2.-Historical daily cumulative proportions of the effort by unguided anglers during the return of late-run chinook salmon to the Kenai River, 1984-1994.

	Daily cumulative proportions [P(t)] by year of unguided angler effort													95% Confidence Interval		Rel[a]
Date	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Mean	SE	Low	High	Prec
7/01	0.009	0.005	0.015	0.004	0.018	0.032	0.051	0.000	0.030	0.012	0.014	0.017	0.005	0.007	0.027	58.8%
7/02	0.022	0.011	0.026	0.016	0.044	0.070	0.051	0.022	0.052	0.027	0.036	0.034	0.005	0.022	0.047	35.3%
7/03	0.040	0.013	0.046	0.053	0.069	0.070	0.091	0.036	0.087	0.056	0.064	0.057	0.007	0.042	0.072	26.9%
7/04	0.063	0.024	0.069	0.090	0.069	0.101	0.109	0.059	0.127	0.090	0.064	0.079	0.009	0.060	0.098	24.1%
7/05	0.092	0.046	0.112	0.142	0.089	0.129	0.138	0.084	0.155	0.090	0.082	0.105	0.010	0.083	0.127	20.9%
7/06	0.108	0.084	0.124	0.142	0.102	0.151	0.169	0.118	0.155	0.112	0.099	0.124	0.008	0.106	0.142	14.6%
7/07	0.163	0.102	0.124	0.162	0.123	0.181	0.209	0.141	0.170	0.134	0.125	0.149	0.009	0.128	0.170	14.2%
7/08	0.214	0.102	0.151	0.184	0.147	0.228	0.242	0.141	0.196	0.166	0.148	0.174	0.013	0.146	0.203	16.3%
7/09	0.214	0.121	0.169	0.211	0.204	0.280	0.242	0.164	0.219	0.188	0.160	0.197	0.013	0.168	0.227	14.9%
7/10	0.237	0.148	0.188	0.250	0.252	0.280	0.269	0.188	0.246	0.240	0.175	0.225	0.013	0.196	0.254	12.8%
7/11	0.260	0.180	0.209	0.299	0.252	0.323	0.297	0.215	0.282	0.311	0.175	0.255	0.016	0.219	0.290	14.0%
7/12	0.280	0.206	0.248	0.336	0.285	0.357	0.331	0.243	0.326	0.311	0.215	0.285	0.016	0.251	0.320	12.2%
7/13	0.306	0.278	0.298	0.336	0.314	0.394	0.361	0.300	0.326	0.348	0.245	0.319	0.012	0.291	0.346	8.6%
7/14	0.367	0.354	0.298	0.387	0.352	0.425	0.422	0.366	0.383	0.382	0.278	0.365	0.014	0.335	0.395	8.3%
7/15	0.431	0.354	0.350	0.418	0.384	0.484	0.490	0.366	0.427	0.425	0.310	0.404	0.017	0.366	0.441	9.4%
7/16	0.431	0.413	0.376	0.450	0.445	0.530	0.490	0.403	0.466	0.465	0.355	0.438	0.015	0.404	0.472	7.7%
7/17	0.462	0.477	0.426	0.491	0.491	0.530	0.542	0.451	0.504	0.518	0.420	0.483	0.012	0.456	0.510	5.6%
7/18	0.506	0.503	0.470	0.547	0.491	0.583	0.590	0.483	0.576	0.572	0.420	0.522	0.017	0.485	0.559	7.1%
7/19	0.556	0.525	0.525	0.595	0.583	0.618	0.645	0.532	0.674	0.572	0.479	0.573	0.017	0.534	0.612	6.8%
7/20	0.594	0.556	0.590	0.595	0.620	0.638	0.679	0.581	0.674	0.622	0.522	0.607	0.014	0.575	0.638	5.2%
7/21	0.649	0.575	0.590	0.633	0.659	0.678	0.766	0.641	0.714	0.672	0.564	0.649	0.018	0.609	0.689	6.2%
7/22	0.705	0.575	0.615	0.654	0.689	0.727	0.836	0.641	0.762	0.723	0.602	0.684	0.023	0.633	0.736	7.5%
7/23	0.705	0.616	0.649	0.686	0.741	0.761	0.836	0.682	0.827	0.753	0.671	0.721	0.021	0.674	0.768	6.5%
7/24	0.741	0.663	0.696	0.727	0.785	0.761	0.881	0.722	0.840	0.789	0.721	0.757	0.019	0.714	0.800	5.6%
7/25	0.778	0.717	0.746	0.790	0.785	0.807	0.930	0.759	0.855	0.825	0.756	0.795	0.018	0.756	0.835	5.0%
7/26	0.801	0.761	0.812	0.840	0.827	0.838	0.975	0.804	0.873	0.825	0.789	0.831	0.017	0.794	0.869	4.5%
7/27	0.842	0.845	0.874	0.840	0.858	0.875	0.986	0.852	0.873	0.860	0.830	0.867	0.013	0.838	0.895	3.3%
7/28	0.894	0.903	0.874	0.884	0.892	0.915	0.992	0.967	0.891	0.894	0.874	0.907	0.011	0.882	0.933	2.8%
7/29	0.957	0.903	0.923	0.920	0.929	0.960	0.996	0.967	0.902	0.934	0.912	0.937	0.009	0.917	0.956	2.1%
7/30	0.957	0.962	0.959	0.959	0.967	1.000	0.996	0.990	0.957	0.967	0.953	0.970	0.005	0.958	0.981	1.2%
7/31	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%

[a] Relative precision.

Appendix B3.-Historical daily cumulative proportions of the harvest of chinook salmon by unguided anglers during the return of late-run chinook salmon to the Kenai River, 1984-1994.

	Daily cumulative proportions [P(t)] by year of harvest by unguided anglers													95% Confidence Interval		Rel[a]
Date	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Mean	SE	Low	High	Prec
7/01	0.002	0.002	0.017	0.002	0.028	0.022	0.071	0.000	0.015	0.019	0.002	0.016	0.006	0.002	0.030	85.1%
7/02	0.011	0.002	0.025	0.002	0.037	0.049	0.071	0.024	0.032	0.023	0.013	0.026	0.006	0.012	0.040	53.0%
7/03	0.027	0.002	0.037	0.102	0.044	0.049	0.157	0.031	0.041	0.030	0.034	0.050	0.013	0.022	0.079	57.1%
7/04	0.044	0.003	0.042	0.119	0.044	0.064	0.168	0.031	0.050	0.051	0.034	0.059	0.014	0.028	0.090	52.0%
7/05	0.060	0.003	0.082	0.193	0.056	0.084	0.168	0.033	0.060	0.051	0.063	0.078	0.017	0.040	0.115	48.2%
7/06	0.067	0.025	0.088	0.193	0.070	0.125	0.245	0.038	0.060	0.109	0.083	0.100	0.020	0.056	0.145	44.3%
7/07	0.083	0.031	0.088	0.213	0.090	0.193	0.253	0.069	0.067	0.124	0.107	0.120	0.021	0.073	0.167	39.0%
7/08	0.131	0.031	0.108	0.226	0.099	0.193	0.268	0.069	0.077	0.201	0.119	0.138	0.022	0.089	0.188	35.9%
7/09	0.131	0.044	0.115	0.250	0.120	0.350	0.268	0.115	0.102	0.238	0.126	0.169	0.028	0.107	0.231	36.8%
7/10	0.140	0.070	0.133	0.321	0.158	0.350	0.275	0.130	0.109	0.287	0.139	0.192	0.029	0.127	0.257	33.8%
7/11	0.149	0.112	0.174	0.328	0.158	0.460	0.275	0.142	0.124	0.379	0.139	0.222	0.036	0.142	0.302	36.1%
7/12	0.157	0.124	0.183	0.367	0.223	0.510	0.303	0.154	0.148	0.379	0.179	0.248	0.038	0.164	0.332	33.8%
7/13	0.165	0.165	0.242	0.367	0.284	0.569	0.328	0.154	0.148	0.439	0.202	0.279	0.041	0.187	0.370	32.9%
7/14	0.179	0.276	0.242	0.380	0.300	0.574	0.364	0.210	0.254	0.467	0.229	0.316	0.036	0.235	0.397	25.5%
7/15	0.225	0.276	0.385	0.419	0.351	0.574	0.487	0.210	0.284	0.511	0.296	0.365	0.036	0.284	0.446	22.2%
7/16	0.225	0.402	0.420	0.438	0.372	0.584	0.487	0.244	0.324	0.542	0.316	0.396	0.035	0.319	0.473	19.5%
7/17	0.294	0.459	0.457	0.476	0.394	0.584	0.593	0.356	0.406	0.586	0.390	0.454	0.030	0.387	0.521	14.7%
7/18	0.345	0.473	0.490	0.499	0.394	0.584	0.650	0.416	0.433	0.632	0.390	0.482	0.031	0.414	0.551	14.1%
7/19	0.401	0.473	0.516	0.529	0.476	0.663	0.711	0.426	0.466	0.632	0.503	0.527	0.030	0.460	0.594	12.7%
7/20	0.485	0.488	0.543	0.529	0.510	0.663	0.718	0.480	0.466	0.656	0.573	0.556	0.026	0.498	0.614	10.4%
7/21	0.595	0.494	0.543	0.565	0.632	0.714	0.730	0.525	0.531	0.685	0.609	0.602	0.024	0.548	0.656	8.9%
7/22	0.705	0.494	0.548	0.596	0.731	0.725	0.832	0.525	0.562	0.709	0.632	0.642	0.032	0.570	0.713	11.1%
7/23	0.705	0.565	0.574	0.615	0.774	0.751	0.832	0.539	0.806	0.722	0.680	0.688	0.031	0.619	0.756	9.9%
7/24	0.771	0.602	0.623	0.670	0.827	0.751	0.932	0.596	0.818	0.744	0.727	0.733	0.032	0.662	0.803	9.6%
7/25	0.820	0.674	0.683	0.704	0.827	0.758	0.971	0.596	0.822	0.779	0.748	0.762	0.030	0.695	0.829	8.8%
7/26	0.835	0.755	0.731	0.752	0.902	0.784	0.989	0.664	0.822	0.779	0.770	0.799	0.026	0.740	0.858	7.4%
7/27	0.860	0.838	0.794	0.752	0.913	0.800	1.000	0.779	0.822	0.839	0.802	0.836	0.021	0.790	0.883	5.6%
7/28	0.881	0.935	0.794	0.813	0.915	0.964	1.000	0.954	0.822	0.893	0.833	0.891	0.021	0.845	0.938	5.2%
7/29	0.936	0.935	0.875	0.858	0.947	0.981	1.000	0.954	0.822	0.936	0.858	0.918	0.017	0.880	0.956	4.1%
7/30	0.936	0.972	0.926	0.903	0.969	1.000	1.000	0.987	0.901	0.970	0.897	0.951	0.012	0.924	0.978	2.8%
7/31	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%

[a] Relative precision.

Appendix B4.-Historical daily cumulative proportions of the catch of chinook salmon by unguided anglers during the return of late-run chinook salmon to the Kenai River, 1984-1994.

	Daily cumulative proportions [P(t)] by year of catch by unguided anglers													95% Confidence Interval		Rel[a]
Date	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Mean	SE	Low	High	Prec
7/01	0.002	0.002	0.013	0.001	0.021	0.014	0.057	0.000	0.063	0.016	0.008	0.018	0.007	0.003	0.033	82.1%
7/02	0.009	0.002	0.017	0.001	0.029	0.044	0.057	0.033	0.076	0.030	0.019	0.029	0.007	0.013	0.044	53.6%
7/03	0.023	0.003	0.034	0.077	0.039	0.044	0.115	0.039	0.081	0.037	0.042	0.049	0.009	0.028	0.069	42.8%
7/04	0.040	0.003	0.048	0.106	0.039	0.094	0.122	0.046	0.088	0.058	0.042	0.062	0.011	0.039	0.086	38.1%
7/05	0.061	0.003	0.080	0.173	0.048	0.133	0.122	0.052	0.094	0.058	0.067	0.081	0.014	0.050	0.113	38.8%
7/06	0.072	0.018	0.089	0.173	0.064	0.163	0.200	0.059	0.094	0.109	0.090	0.103	0.016	0.066	0.140	35.8%
7/07	0.100	0.024	0.089	0.191	0.090	0.227	0.217	0.084	0.110	0.123	0.115	0.125	0.019	0.083	0.166	33.6%
7/08	0.137	0.024	0.122	0.205	0.102	0.227	0.235	0.084	0.116	0.204	0.134	0.145	0.020	0.100	0.189	30.7%
7/09	0.137	0.038	0.128	0.230	0.124	0.327	0.235	0.123	0.145	0.250	0.139	0.170	0.024	0.116	0.225	31.8%
7/10	0.144	0.066	0.138	0.283	0.178	0.327	0.245	0.136	0.157	0.324	0.149	0.195	0.026	0.137	0.253	29.6%
7/11	0.153	0.112	0.174	0.295	0.178	0.420	0.259	0.146	0.177	0.407	0.149	0.225	0.032	0.153	0.296	32.0%
7/12	0.160	0.127	0.180	0.344	0.256	0.487	0.313	0.156	0.200	0.407	0.178	0.255	0.035	0.176	0.334	30.9%
7/13	0.168	0.159	0.270	0.344	0.336	0.524	0.340	0.156	0.200	0.465	0.198	0.287	0.038	0.202	0.372	29.6%
7/14	0.180	0.276	0.270	0.370	0.356	0.529	0.393	0.203	0.281	0.500	0.221	0.325	0.035	0.248	0.403	23.9%
7/15	0.218	0.276	0.444	0.402	0.395	0.529	0.475	0.203	0.301	0.554	0.270	0.370	0.037	0.287	0.453	22.4%
7/16	0.218	0.414	0.470	0.424	0.415	0.539	0.475	0.294	0.333	0.579	0.296	0.405	0.033	0.331	0.479	18.3%
7/17	0.301	0.484	0.505	0.471	0.433	0.539	0.662	0.388	0.381	0.614	0.368	0.468	0.033	0.395	0.541	15.6%
7/18	0.372	0.497	0.528	0.499	0.433	0.672	0.707	0.439	0.422	0.656	0.368	0.508	0.036	0.428	0.589	15.9%
7/19	0.430	0.499	0.545	0.530	0.529	0.723	0.748	0.446	0.450	0.656	0.499	0.550	0.033	0.476	0.625	13.5%
7/20	0.509	0.516	0.559	0.530	0.556	0.723	0.763	0.500	0.450	0.675	0.574	0.578	0.030	0.511	0.645	11.6%
7/21	0.598	0.522	0.559	0.571	0.669	0.755	0.790	0.538	0.488	0.699	0.609	0.618	0.030	0.552	0.684	10.7%
7/22	0.718	0.522	0.566	0.598	0.754	0.773	0.874	0.538	0.526	0.726	0.638	0.658	0.036	0.578	0.737	12.1%
7/23	0.718	0.587	0.586	0.617	0.787	0.795	0.874	0.549	0.675	0.737	0.692	0.693	0.031	0.624	0.761	9.9%
7/24	0.778	0.625	0.619	0.663	0.834	0.795	0.948	0.614	0.709	0.754	0.733	0.734	0.031	0.664	0.803	9.5%
7/25	0.826	0.683	0.679	0.704	0.834	0.799	0.981	0.614	0.747	0.785	0.756	0.764	0.030	0.698	0.831	8.7%
7/26	0.846	0.754	0.719	0.757	0.912	0.833	0.992	0.671	0.792	0.785	0.772	0.803	0.027	0.743	0.863	7.5%
7/27	0.871	0.833	0.770	0.757	0.923	0.843	1.000	0.768	0.792	0.845	0.801	0.837	0.022	0.787	0.886	5.9%
7/28	0.898	0.907	0.770	0.823	0.927	0.973	1.000	0.960	0.829	0.899	0.847	0.894	0.021	0.846	0.941	5.3%
7/29	0.946	0.907	0.847	0.867	0.951	0.984	1.000	0.960	0.874	0.945	0.875	0.923	0.016	0.889	0.958	3.8%
7/30	0.946	0.975	0.917	0.908	0.974	1.000	1.000	0.989	0.937	0.970	0.911	0.957	0.011	0.934	0.981	2.4%
7/31	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%

[a] Relative precision.

Appendix B5.-Historical daily cumulative proportions of the effort by guided anglers during the return of late-run chinook salmon to the Kenai River, 1984-1994.

	Daily cumulative proportions [P(t)] by year of guided angler effort													95% Confidence Interval		Rel[a]
Date	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Mean	SE	Low	High	Prec
7/01	0.000	0.023	0.025	0.006	0.025	0.032	0.000	0.000	0.035	0.021	0.025	0.017	0.004	0.009	0.026	50.9%
7/02	0.014	0.029	0.039	0.028	0.045	0.032	0.000	0.033	0.059	0.046	0.047	0.034	0.005	0.023	0.045	32.7%
7/03	0.027	0.033	0.055	0.055	0.045	0.032	0.045	0.063	0.088	0.068	0.047	0.051	0.005	0.039	0.063	23.5%
7/04	0.047	0.044	0.079	0.077	0.045	0.073	0.076	0.092	0.109	0.068	0.047	0.069	0.006	0.055	0.083	20.7%
7/05	0.073	0.064	0.103	0.077	0.079	0.104	0.102	0.131	0.109	0.068	0.086	0.091	0.006	0.077	0.105	15.4%
7/06	0.123	0.087	0.103	0.077	0.111	0.140	0.134	0.162	0.109	0.107	0.120	0.116	0.007	0.100	0.132	14.0%
7/07	0.199	0.087	0.103	0.107	0.138	0.179	0.173	0.162	0.151	0.128	0.163	0.145	0.011	0.121	0.168	16.4%
7/08	0.199	0.087	0.152	0.129	0.173	0.213	0.173	0.162	0.188	0.162	0.196	0.167	0.011	0.143	0.191	14.3%
7/09	0.199	0.122	0.181	0.172	0.211	0.213	0.173	0.223	0.217	0.189	0.226	0.193	0.009	0.173	0.214	10.6%
7/10	0.252	0.169	0.206	0.204	0.211	0.213	0.232	0.263	0.250	0.232	0.226	0.223	0.008	0.205	0.241	8.0%
7/11	0.320	0.228	0.242	0.225	0.211	0.276	0.290	0.309	0.291	0.232	0.226	0.259	0.012	0.233	0.285	10.0%
7/12	0.360	0.279	0.294	0.225	0.267	0.335	0.349	0.344	0.291	0.232	0.302	0.298	0.014	0.267	0.329	10.3%
7/13	0.412	0.322	0.294	0.225	0.319	0.388	0.409	0.388	0.291	0.292	0.356	0.336	0.018	0.296	0.376	11.9%
7/14	0.484	0.322	0.294	0.308	0.374	0.444	0.459	0.388	0.349	0.346	0.404	0.379	0.019	0.337	0.422	11.2%
7/15	0.484	0.322	0.339	0.384	0.408	0.493	0.459	0.388	0.398	0.397	0.454	0.411	0.017	0.374	0.449	9.1%
7/16	0.484	0.416	0.392	0.437	0.461	0.493	0.459	0.444	0.443	0.442	0.510	0.453	0.010	0.430	0.476	5.0%
7/17	0.534	0.485	0.455	0.486	0.461	0.493	0.507	0.509	0.475	0.485	0.510	0.491	0.007	0.475	0.506	3.2%
7/18	0.609	0.530	0.510	0.538	0.461	0.565	0.628	0.551	0.521	0.485	0.510	0.537	0.015	0.504	0.570	6.2%
7/19	0.654	0.577	0.569	0.538	0.527	0.621	0.692	0.604	0.521	0.485	0.564	0.577	0.019	0.536	0.619	7.1%
7/20	0.723	0.627	0.569	0.538	0.591	0.674	0.736	0.655	0.521	0.555	0.618	0.619	0.022	0.570	0.667	7.9%
7/21	0.737	0.627	0.569	0.596	0.650	0.724	0.793	0.655	0.608	0.616	0.660	0.658	0.020	0.612	0.703	6.9%
7/22	0.737	0.627	0.617	0.630	0.685	0.774	0.793	0.655	0.669	0.674	0.701	0.687	0.018	0.648	0.727	5.8%
7/23	0.737	0.677	0.645	0.679	0.745	0.774	0.793	0.713	0.730	0.709	0.744	0.722	0.013	0.693	0.752	4.1%
7/24	0.793	0.731	0.705	0.735	0.745	0.774	0.866	0.767	0.763	0.760	0.744	0.762	0.013	0.734	0.790	3.7%
7/25	0.842	0.790	0.770	0.782	0.745	0.837	0.918	0.813	0.785	0.760	0.784	0.802	0.015	0.770	0.835	4.1%
7/26	0.874	0.841	0.829	0.782	0.807	0.884	0.962	0.859	0.785	0.760	0.816	0.836	0.017	0.798	0.875	4.6%
7/27	0.926	0.918	0.829	0.782	0.864	0.922	0.990	0.912	0.785	0.822	0.866	0.874	0.020	0.830	0.918	5.1%
7/28	0.951	0.918	0.829	0.842	0.915	0.961	0.995	0.912	0.825	0.870	0.920	0.903	0.017	0.866	0.941	4.2%
7/29	0.951	0.918	0.902	0.894	0.960	1.000	0.995	0.912	0.857	0.923	0.957	0.934	0.013	0.904	0.963	3.1%
7/30	0.951	0.960	0.961	0.944	1.000	1.000	0.995	0.960	0.929	0.967	1.000	0.970	0.008	0.953	0.987	1.7%
7/31	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%

[a] Relative precision.

Appendix B6.-Historical daily cumulative proportions of the harvest of chinook salmon by guided anglers during the return of late-run chinook salmon to the Kenai River, 1984-1994.

	Daily cumulative proportions [P(t)] by year of harvest by guided anglers													95% Confidence Interval		Rel[a]
Date	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Mean	SE	Low	High	Prec
7/01	0.000	0.037	0.013	0.008	0.026	0.013	0.000	0.000	0.045	0.029	0.034	0.019	0.005	0.008	0.030	58.8%
7/02	0.008	0.039	0.019	0.041	0.034	0.013	0.000	0.031	0.059	0.047	0.057	0.032	0.006	0.019	0.045	41.4%
7/03	0.030	0.041	0.030	0.085	0.034	0.013	0.027	0.068	0.059	0.059	0.057	0.046	0.006	0.031	0.060	31.5%
7/04	0.055	0.047	0.049	0.118	0.034	0.060	0.072	0.079	0.066	0.059	0.057	0.063	0.007	0.049	0.078	23.3%
7/05	0.080	0.058	0.055	0.118	0.064	0.085	0.107	0.079	0.066	0.059	0.117	0.081	0.007	0.065	0.097	19.8%
7/06	0.128	0.079	0.055	0.118	0.111	0.136	0.167	0.129	0.066	0.097	0.153	0.113	0.011	0.089	0.136	21.1%
7/07	0.197	0.079	0.055	0.157	0.129	0.220	0.201	0.129	0.088	0.125	0.209	0.144	0.017	0.106	0.183	26.5%
7/08	0.197	0.079	0.088	0.179	0.169	0.241	0.201	0.129	0.118	0.187	0.248	0.167	0.017	0.129	0.205	22.9%
7/09	0.197	0.109	0.102	0.215	0.193	0.241	0.201	0.129	0.127	0.230	0.290	0.185	0.018	0.144	0.226	22.0%
7/10	0.223	0.155	0.109	0.237	0.193	0.241	0.237	0.154	0.155	0.298	0.290	0.208	0.018	0.168	0.249	19.5%
7/11	0.249	0.217	0.143	0.244	0.193	0.316	0.262	0.211	0.202	0.298	0.290	0.239	0.016	0.204	0.273	14.6%
7/12	0.264	0.248	0.164	0.244	0.271	0.367	0.343	0.234	0.202	0.298	0.348	0.271	0.019	0.229	0.314	15.7%
7/13	0.301	0.281	0.164	0.244	0.297	0.469	0.407	0.246	0.202	0.375	0.391	0.307	0.028	0.244	0.370	20.5%
7/14	0.332	0.281	0.164	0.297	0.346	0.496	0.442	0.246	0.311	0.440	0.427	0.344	0.030	0.277	0.411	19.4%
7/15	0.332	0.281	0.207	0.345	0.392	0.508	0.442	0.246	0.380	0.501	0.482	0.374	0.031	0.305	0.444	18.5%
7/16	0.332	0.374	0.283	0.387	0.424	0.508	0.442	0.321	0.418	0.552	0.528	0.415	0.026	0.356	0.474	14.2%
7/17	0.384	0.428	0.330	0.442	0.424	0.508	0.528	0.347	0.445	0.591	0.528	0.450	0.025	0.396	0.505	12.1%
7/18	0.438	0.444	0.407	0.475	0.424	0.635	0.649	0.422	0.469	0.591	0.528	0.498	0.027	0.439	0.558	12.0%
7/19	0.483	0.469	0.446	0.475	0.490	0.709	0.709	0.514	0.469	0.591	0.603	0.542	0.029	0.477	0.607	12.0%
7/20	0.578	0.493	0.446	0.475	0.529	0.720	0.734	0.571	0.469	0.608	0.678	0.573	0.031	0.504	0.641	12.0%
7/21	0.606	0.493	0.446	0.513	0.592	0.753	0.821	0.571	0.515	0.665	0.705	0.607	0.035	0.528	0.686	13.0%
7/22	0.606	0.493	0.495	0.541	0.680	0.809	0.821	0.571	0.596	0.684	0.738	0.640	0.035	0.562	0.717	12.2%
7/23	0.606	0.607	0.509	0.619	0.778	0.809	0.821	0.600	0.628	0.706	0.768	0.677	0.031	0.608	0.747	10.3%
7/24	0.688	0.675	0.561	0.682	0.778	0.809	0.882	0.647	0.628	0.737	0.768	0.714	0.028	0.653	0.775	8.6%
7/25	0.748	0.743	0.627	0.742	0.778	0.868	0.916	0.696	0.628	0.737	0.794	0.752	0.027	0.693	0.812	7.9%
7/26	0.820	0.761	0.664	0.742	0.863	0.899	0.969	0.754	0.628	0.737	0.819	0.787	0.030	0.720	0.854	8.6%
7/27	0.903	0.876	0.664	0.742	0.905	0.943	0.983	0.848	0.628	0.812	0.887	0.836	0.034	0.759	0.912	9.1%
7/28	0.924	0.876	0.664	0.794	0.923	1.000	0.985	0.848	0.633	0.882	0.941	0.861	0.036	0.780	0.942	9.4%
7/29	0.924	0.876	0.818	0.853	0.956	1.000	0.985	0.848	0.633	0.917	0.965	0.889	0.031	0.819	0.958	7.9%
7/30	0.924	0.936	0.924	0.906	1.000	1.000	0.985	0.945	0.843	0.983	1.000	0.950	0.015	0.916	0.983	3.5%
7/31	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%

[a] Relative precision.

Appendix B7.-Historical daily cumulative proportions of the catch of chinook salmon by guided anglers during the return of late-run chinook salmon to the Kenai River, 1984-1994.

	Daily cumulative proportions [P(t)] by year of catch by guided anglers													95% Confidence Interval		Rel[a]
Date	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Mean	SE	Low	High	Prec
7/01	0.000	0.031	0.017	0.006	0.019	0.011	0.000	0.000	0.036	0.024	0.031	0.016	0.004	0.007	0.025	56.6%
7/02	0.010	0.033	0.027	0.040	0.025	0.011	0.000	0.033	0.045	0.044	0.051	0.029	0.005	0.018	0.040	38.0%
7/03	0.026	0.034	0.036	0.080	0.025	0.011	0.030	0.063	0.045	0.062	0.051	0.042	0.006	0.028	0.056	32.4%
7/04	0.047	0.038	0.059	0.114	0.025	0.049	0.064	0.072	0.051	0.062	0.051	0.058	0.007	0.042	0.073	26.5%
7/05	0.072	0.045	0.069	0.114	0.051	0.080	0.095	0.092	0.051	0.062	0.117	0.077	0.008	0.060	0.094	21.7%
7/06	0.117	0.061	0.069	0.114	0.094	0.125	0.148	0.132	0.051	0.098	0.160	0.106	0.011	0.083	0.130	22.3%
7/07	0.176	0.061	0.069	0.160	0.112	0.193	0.181	0.132	0.067	0.124	0.212	0.135	0.016	0.099	0.171	26.8%
7/08	0.176	0.061	0.114	0.179	0.141	0.217	0.181	0.132	0.088	0.176	0.249	0.156	0.017	0.119	0.193	23.8%
7/09	0.176	0.115	0.127	0.217	0.160	0.217	0.181	0.136	0.095	0.217	0.286	0.175	0.017	0.137	0.213	21.6%
7/10	0.202	0.181	0.135	0.234	0.160	0.217	0.208	0.165	0.132	0.281	0.286	0.200	0.016	0.165	0.235	17.6%
7/11	0.239	0.257	0.163	0.241	0.160	0.320	0.234	0.218	0.166	0.281	0.286	0.233	0.016	0.197	0.269	15.3%
7/12	0.256	0.280	0.182	0.241	0.234	0.376	0.315	0.241	0.166	0.281	0.342	0.265	0.019	0.222	0.307	16.0%
7/13	0.285	0.315	0.182	0.241	0.260	0.493	0.377	0.251	0.166	0.355	0.380	0.300	0.029	0.236	0.365	21.5%
7/14	0.316	0.315	0.182	0.282	0.314	0.516	0.415	0.251	0.259	0.421	0.413	0.335	0.029	0.270	0.399	19.3%
7/15	0.316	0.315	0.249	0.335	0.365	0.535	0.415	0.251	0.314	0.490	0.463	0.368	0.029	0.304	0.432	17.5%
7/16	0.316	0.443	0.345	0.377	0.391	0.535	0.415	0.363	0.349	0.547	0.505	0.417	0.024	0.363	0.471	12.9%
7/17	0.382	0.507	0.409	0.428	0.391	0.535	0.504	0.395	0.374	0.585	0.505	0.456	0.022	0.407	0.505	10.8%
7/18	0.452	0.521	0.468	0.454	0.391	0.655	0.676	0.454	0.394	0.585	0.505	0.505	0.029	0.440	0.570	12.8%
7/19	0.503	0.538	0.501	0.454	0.451	0.724	0.738	0.533	0.394	0.585	0.599	0.547	0.033	0.475	0.620	13.3%
7/20	0.606	0.557	0.501	0.454	0.489	0.733	0.766	0.588	0.394	0.602	0.687	0.580	0.035	0.501	0.658	13.5%
7/21	0.631	0.557	0.501	0.494	0.610	0.763	0.837	0.588	0.427	0.657	0.711	0.616	0.037	0.534	0.698	13.3%
7/22	0.631	0.557	0.534	0.524	0.698	0.809	0.837	0.588	0.499	0.680	0.739	0.645	0.035	0.567	0.724	12.2%
7/23	0.631	0.665	0.545	0.598	0.788	0.809	0.837	0.613	0.523	0.700	0.767	0.680	0.033	0.607	0.753	10.7%
7/24	0.721	0.719	0.583	0.654	0.788	0.809	0.893	0.675	0.553	0.729	0.767	0.717	0.030	0.651	0.784	9.3%
7/25	0.777	0.780	0.641	0.735	0.788	0.860	0.937	0.724	0.576	0.729	0.792	0.758	0.029	0.693	0.823	8.6%
7/26	0.840	0.794	0.681	0.735	0.869	0.905	0.977	0.792	0.576	0.729	0.813	0.792	0.033	0.718	0.866	9.4%
7/27	0.912	0.910	0.681	0.735	0.921	0.945	0.987	0.878	0.576	0.808	0.876	0.839	0.038	0.754	0.924	10.1%
7/28	0.929	0.910	0.681	0.809	0.935	0.995	0.989	0.878	0.638	0.880	0.923	0.870	0.035	0.792	0.948	9.0%
7/29	0.929	0.910	0.826	0.861	0.962	1.000	0.989	0.878	0.659	0.920	0.946	0.898	0.029	0.834	0.962	7.1%
7/30	0.929	0.957	0.927	0.919	1.000	1.000	0.989	0.955	0.855	0.976	1.000	0.955	0.014	0.925	0.986	3.2%
7/31	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%

[a] Relative precision.