

Fishery Data Series No. 03-12

**Survey of the Chinook and Coho Salmon Sport
Fishery in the Alagnak River, Alaska, 2001 and
2002**

**Final Report for Study 01-173
USFWS Office of Subsistence Management
Fishery Information Services Division**

by

Craig N. Collins

and

Jason E. Dye

July 2003

Alaska Department of Fish and Game

Division of Sport Fish



Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition. All others must be defined in the text at first mention, as well as in the titles or footnotes of tables and in figures or figure captions.

Weights and measures (metric)		General		Mathematics, statistics, fisheries	
centimeter	cm	All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.	alternate hypothesis	H _A
deciliter	dL	All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.	base of natural logarithm	e
gram	g	and	&	catch per unit effort	CPUE
hectare	ha	at	@	coefficient of variation	CV
kilogram	kg	Compass directions:		common test statistics	F, t, χ^2 , etc.
kilometer	km	east	E	confidence interval	C.I.
liter	L	north	N	correlation coefficient	R (multiple)
meter	m	south	S	correlation coefficient	r (simple)
metric ton	mt	west	W	covariance	cov
milliliter	ml	Copyright	©	degree (angular or temperature)	°
millimeter	mm	Corporate suffixes:		degrees of freedom	df
Weights and measures (English)		Company	Co.	divided by	÷ or / (in equations)
cubic feet per second	ft ³ /s	Corporation	Corp.	equals	=
foot	ft	Incorporated	Inc.	expected value	E
gallon	gal	Limited	Ltd.	fork length	FL
inch	in	et alii (and other people)	et al.	greater than	>
mile	mi	et cetera (and so forth)	etc.	greater than or equal to	≥
ounce	oz	exempli gratia (for example)	e.g.,	harvest per unit effort	HPUE
pound	lb	id est (that is)	i.e.,	less than	<
quart	qt	latitude or longitude	lat. or long.	less than or equal to	≤
yard	yd	monetary symbols (U.S.)	\$, ¢	logarithm (natural)	ln
Spell out acre and ton.		months (tables and figures): first three letters	Jan, ..., Dec	logarithm (base 10)	log
Time and temperature		number (before a number)	# (e.g., #10)	logarithm (specify base)	log ₂ , etc.
day	d	pounds (after a number)	# (e.g., 10#)	mideye-to-fork	MEF
degrees Celsius	°C	registered trademark	®	minute (angular)	'
degrees Fahrenheit	°F	trademark	™	multiplied by	x
hour (spell out for 24-hour clock)	h	United States (adjective)	U.S.	not significant	NS
minute	min	United States of America (noun)	USA	null hypothesis	H ₀
second	s	U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)	percent	%
Spell out year, month, and week.				probability	P
Physics and chemistry				probability of a type I error (rejection of the null hypothesis when true)	α
all atomic symbols				probability of a type II error (acceptance of the null hypothesis when false)	β
alternating current	AC			second (angular)	"
ampere	A			standard deviation	SD
calorie	cal			standard error	SE
direct current	DC			standard length	SL
hertz	Hz			total length	TL
horsepower	hp			variance	Var
hydrogen ion activity	pH				
parts per million	ppm				
parts per thousand	ppt, ‰				
volts	V				
watts	W				

FISHERY DATA SERIES NO. 03-12

**SURVEY OF THE CHINOOK AND COHO SALMON SPORT FISHERY IN
THE ALAGNAK RIVER, ALASKA, 2001 AND 2002**

by

Craig N. Collins

and

Jason E. Dye

Division of Sport Fish, Dillingham

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1599

July 2003

This investigation was partially financed by the U.S. Fish and Wildlife Service, Office of Subsistence Management through the Fisheries Resource Monitoring Program, under agreement number 70181-1J333.

The Fishery Data Series was established in 1987 for the publication of technically-oriented results for a single project or group of closely related projects. Fishery Data Series reports are intended for fishery and other technical professionals. Fishery Data Series reports 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.

Craig N. Collins and Jason E. Dye

*Alaska Department of Fish and Game, Division of Sport Fish
P.O. Box 230, Dillingham, AK 99576-0230, USA*

This document should be cited as:

Collins, C. N., and J. E. Dye. 2003. Survey of the chinook and coho salmon sport fishery in the Alagnak River, Alaska, 2001 and 2002. Fishery Data Series No. 03-12, Anchorage, Alaska.

The Alaska Department of Fish and Game administers all programs and activities free from discrimination based on race, color, national origin, age, sex, religion, marital status, pregnancy, parenthood, or disability. The department administers all programs and activities in compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972.

If you believe you have been discriminated against in any program, activity, or facility, or if you desire further information please write to ADF&G, P.O. Box 25526, Juneau, AK 99802-5526; U.S. Fish and Wildlife Service, 4040 N. Fairfax Drive, Suite 300 Webb, Arlington, VA 22203; or O.E.O., U.S. Department of the Interior, Washington DC 20240.

For information on alternative formats for this and other department publications, please contact the department ADA Coordinator at (voice) 907-465-4120, (TDD) 907-465-3646, or (FAX) 907-465-2440.

TABLE OF CONTENTS

	Page
LIST OF TABLES	ii
LIST OF FIGURES	ii
LIST OF APPENDICES	ii
ABSTRACT	1
INTRODUCTION	1
OBJECTIVES	5
METHODS	7
Study Design.....	7
Creel Survey	7
Index of Upriver Angler Effort	9
Distribution of Angler Success and Demographics.....	9
Biological Data	9
Data Collection.....	9
Angler Counts	9
Angler Interviews	10
Biological Data	10
Data Analysis.....	10
Angler Effort	10
Harvest and Catch	11
CPUE as an Index of Angler Success.....	13
Distributions of Angler Catches and Harvests	14
Angler Characteristics	14
Biological Data	15
RESULTS	15
Chinook Salmon Fishery	15
Angler Success.....	15
Angler Characteristics	16
Biological Composition.....	17
Coho Salmon Fishery	18
Angler Success.....	20
Angler Characteristics	23
Biological Composition.....	23
DISCUSSION	23
Chinook Salmon Fishery	24
Coho Salmon Fishery	27
CONCLUSIONS AND RECOMMENDATIONS	28
ACKNOWLEDGEMENTS	28
LITERATURE CITED	29
APPENDIX A. SUPPORTING DATA	33

LIST OF TABLES

Table	Page
1. Sport fishing effort for all species, and harvest and catch of chinook and coho salmon at the Alagnak River, 1981-2001.	4
2. Unexpanded escapement counts of chinook salmon in the Alagnak River, 1970 to 2001.	6
3. Catch per unit effort for the chinook salmon sport fishery in the lower Alagnak River, 25 June-31 July, 2001 and 2002.	16
4. Distribution of catch and harvest during the chinook salmon sport fishery on the lower Alagnak River, 25 June-31 July, 2001 and 2002.	17
5. Number and percent of angler trips by angler and gear type during the chinook salmon sport fishery on the lower Alagnak River, 25 June-31 July, 2001 and 2002.	18
6. Mean lengths (millimeters) and weights (kilograms) of chinook salmon, by sex and age group, from samples collected from the lower Alagnak River sport harvest, 6 June-31 July, 2001.	19
7. Mean lengths (millimeters) and weights (kilograms) of chinook salmon, by sex and age group, from samples collected from the lower Alagnak River sport harvest, 6 June-31 July, 2002.	20
8. Catch per unit effort for the coho salmon sport fishery in the lower Alagnak River, 1-28 August, 2001.	21
9. Distribution of catch and harvest during the coho salmon sport fishery on the lower Alagnak River, 1-16 August, 2001 and 2002.	22
10. Number and percent of angler trips by angler and gear type during the coho salmon sport fishery on the lower and upper Alagnak River, 1-28 August, 2001 and 2002.	24
11. Mean lengths (millimeters) and weights (grams) of coho salmon, by sex and age group, from samples collected from the lower Alagnak River sport harvest, 7-26 August, 2001.	25
12. Mean lengths (millimeters) and weights (grams) of coho salmon, by sex and age group, from samples collected from the lower Alagnak River sport harvest, 7-26 August, 2002.	26
13. Comparison of catch rates, angler characteristics, and gear selection observed during surveys of the chinook salmon sport fishery in the lower Alagnak River in 1989, 1993, 1998, 2001, and 2002.	27

LIST OF FIGURES

Figure	Page
1. Popular chinook and coho salmon sport fisheries in the Southwest Alaska Management Area.	2
2. Sport fishing effort for all species, and harvest of chinook and coho salmon at the Alagnak River, 1981-2001.	3
3. Alagnak River chinook and coho salmon angler survey site.	7

LIST OF APPENDICES

Appendix	Page
A1. Daily statistics for days sampled during the chinook salmon fishery on the lower Alagnak River, 25 June-31 July, 2001.	34
A2. Daily statistics for days sampled during the chinook salmon fishery on the lower Alagnak River, 25 June-31 July, 2002.	35
A3. Daily statistics for days sampled during the coho salmon fishery on the lower Alagnak River, 1-28 August, 2001.	36
A4. Daily statistics for days sampled during the coho salmon fishery on the lower Alagnak River, 1-28 August, 2002.	37
A5. Numbers of anglers counted in the upper area of the Alagnak River during the chinook and coho salmon fisheries, 2001 and 2002.	38

ABSTRACT

A survey of the sport fishery for chinook *Oncorhynchus tshawytscha* and coho *Oncorhynchus kisutch* salmon was conducted on the lower Alagnak River from 25 June-28 August, 2001 and 2002. A separate angler count was also conducted on the upper 10 miles of the salmon fishery to index effort. In 2001, 1,469 anglers were interviewed for information on effort, catch and harvest of chinook and coho salmon, and demographic characteristics. In 2002, 1,333 anglers were interviewed. In both years during both surveys, most anglers were guided, non-Alaskan residents, and male. During the chinook salmon survey, most anglers used spin tackle; during the coho salmon survey most used fly tackle.

During the 2001 chinook salmon survey (25 June-31 July), 1,023 anglers were interviewed. Estimated catch rate was 0.11 (SE = 0.01) chinook salmon/hour, estimated effort was 13,813 (SE = 1,295) angler-hours, and estimated harvest was 522 (SE = 92) chinook salmon. Total mean angler counts ranged from 1.3 to 49.7 in the lower survey area. Total angler counts in the upper area ranged from 0 to 18. Age, sex, length, and weight data were collected from 124 harvested chinook salmon. The predominant age group was 1.4 (51%; SE = 5) and the predominant sex was male (69%; SE = 5). Mean mid-eye fork length (MEF) was 831 mm (SE = 12) and mean weight was 10.4 kg (SE = 0.4).

During the 2002 chinook salmon survey, 983 anglers were interviewed. Estimated catch rate was 0.16 (SE = 0.01) chinook salmon/hour, effort was 12,229 (SE = 1,096), and harvest was 614 (SE = 103) chinook salmon. Total mean angler counts ranged from 0 to 48.0 in the lower area. Total angler counts in the upper area ranged from 0 to 11. Age, sex, length, and weight data were collected from 139 chinook salmon. The predominant age group was 1.3 (35%; SE = 4) and the predominant sex was male (76%; SE = 4). Mean MEF was 741 mm (SE = 13) and mean weight was 7.8 kg (SE = 0.4).

During the 2001 coho salmon survey (1-28 August) 446 anglers were interviewed. Overall estimated catch rate was 0.23 (SE = 0.03) coho salmon/hour, estimated effort was 3,117 (SE = 283) angler-hours, and estimated harvest was 271 (SE = 91) coho salmon. Total mean angler counts ranged from 1.0 to 21.7. Total angler counts in the upper area ranged from 0 to 9. Age, sex, length, and weight data were collected from 129 coho salmon. The predominant age group was 2.1 (53%; SE = 5) and the predominant sex was male (72%; SE = 4). Mean MEF was 617 mm (SE = 3) and mean weight was 4,356 g (SE = 63).

During the 2002 coho salmon survey, overall catch rate was 0.31 (SE = 0.02) coho salmon/hour, effort was 3,781 (SE = 584) angler-hours, and harvest was 201 (SE = 52) coho salmon. Total mean angler counts ranged from 0.3 to 23.5 in the lower area. Total angler counts in the upper area ranged from 2 to 13. Age, sex, length, and weight data were collected from 99 coho salmon. The predominant age group was 2.1 (54%; SE = 6) and the predominant sex was male (81%; SE = 4). Mean MEF was 623 mm (SE = 3) and mean weight was 4,286 (SE = 70).

Key words: chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *Oncorhynchus kisutch*, Alagnak River, catch rates, angler characteristics, and biological composition.

INTRODUCTION

The Alagnak River, known locally as the Branch River, is located in the Kvichak River drainage (Figure 1) approximately 60 km (40 miles) north of the community of King Salmon, Alaska. The Alagnak River hosts significant recreational fisheries for chinook salmon *Oncorhynchus tshawytscha*, coho salmon *O. kisutch*, chum salmon *O. keta*, rainbow trout *O. mykiss*, and several other species. The Alagnak River's proximity to the community of King Salmon makes it an attractive alternative to fishing the more crowded Naknek River. Anglers typically access the river from various lodges located on the river, and by float-equipped aircraft from King Salmon or other lodge sites within the area.

Alagnak River chinook salmon are particularly attractive to sport anglers due to the remote setting and availability of slightly larger fish with slightly later run timing (mid July) than other nearby Bristol Bay rivers. Coho salmon are very popular with anglers and especially so on the

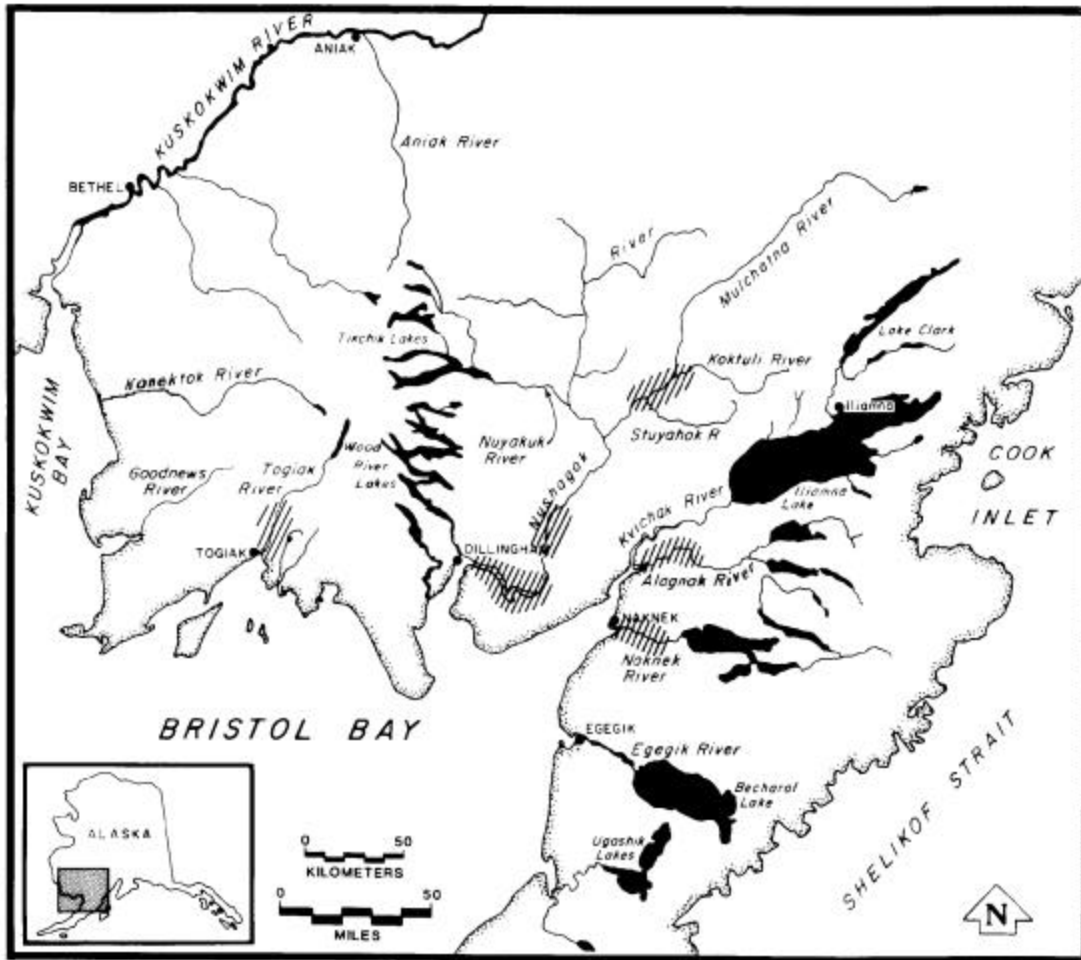
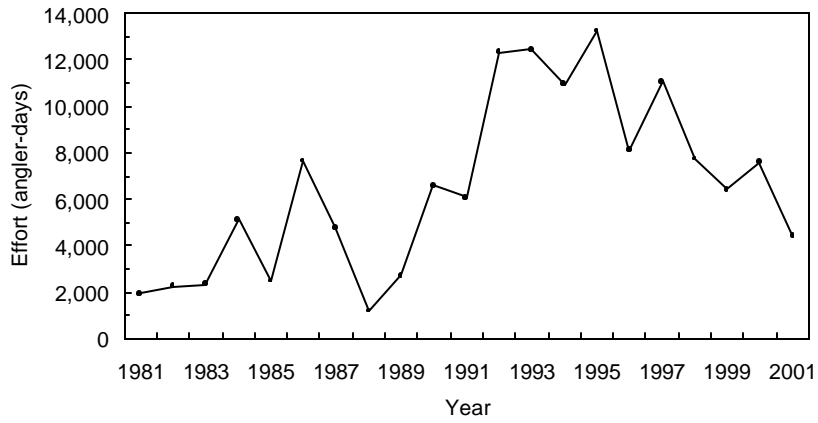


Figure 1.-Popular chinook and coho salmon sport fisheries in the Southwest Alaska Management Area.

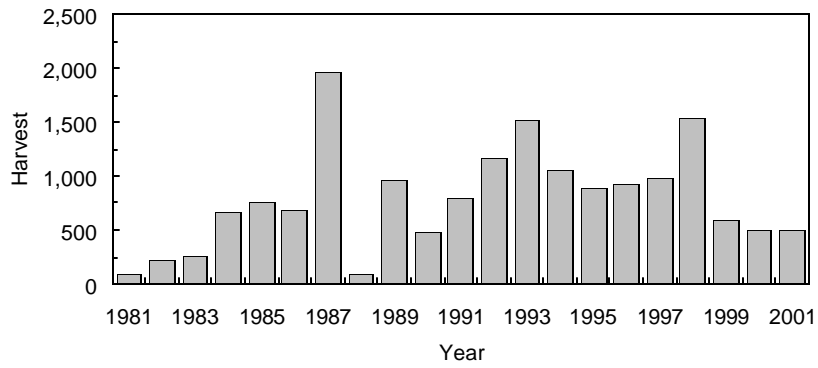
Alagnak River where anglers can arrange a trip to pursue coho as well as chum salmon, rainbow trout, Arctic grayling *Thymallus arcticus*, and char *Salvelinus*.

Annual sport fishing effort at the Alagnak River, first estimated by the Statewide Harvest Survey (SWHS) for 1981, was variable during the 1980s (Figure 2). Effort increased substantially in the late 1980s and early 1990s, but decreased during the mid and late 1990s (Figure 2). Harvest of chinook salmon peaked at almost 2,000 fish in 1987 (Table 1), but has been relatively stable since then (Figure 2). Sport harvest of coho salmon was highly variable from 1981-2001 (Figure 2) and its unpredictability has created some concern among anglers and fishery managers.

In response to the increased sport fishing effort at the Alagnak River during the early 1990s, the Alaska Board of Fisheries (BOF) reduced the daily bag limit of chinook salmon in 1998 from three fish of which two could exceed 28 inches in length to three fish of which one could exceed 28 inches in length. In addition, the BOF established a Bristol Bay annual bag limit of five chinook salmon and a spawning season closure of 31 July (ADF&G 1998). Guides were also prohibited from retaining fish while guiding. At the same time, the coho salmon daily bag limit was reduced from five fish per day to three fish per day.



Harvest of Chinook Salmon



Harvest of Coho Salmon

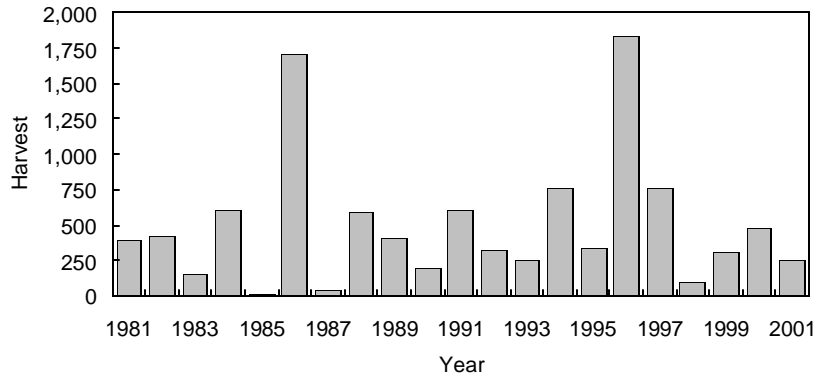


Figure 2.-Sport fishing effort for all species, and harvest of chinook and coho salmon at the Alagnak River, 1981-2001.

Table 1.-Sport fishing effort for all species, and harvest and catch of chinook and coho salmon at the Alagnak River, 1981-2001.

Year	Effort ^a (angler-days)	Chinook		Coho	
		Harvest	Catch	Harvest	Catch
1981	1,947	97		400	
1982	2,252	220		422	
1983	2,348	252		147	
1984	5,119	661		599	
1985	2,473	757		11	
1986	7,628	680		1,699	
1987	4,786	1,969		46	
1988 ^b	1,182	93		588	
1989	2,717	959		403	
1990	6,571	474	2,515	194	2,346
1991	6,079	790	3,224	602	1,283
1992	12,323	1,160	7,636	324	2,964
1993	12,440	1,515	14,123	246	2,358
1994	10,949	1,048	1,884	763	2,088
1995	13,232	891	3,916	331	1,578
1996	8,121	931	4,899	1,834	14,635
1997	11,062	982	5,573	763	4,120
1998	7,715	1,531	9,087	100	1,149
1999	6,411	592	1,780	305	1,644
2000	7,589	501	1,766	480	1,718
2001	4,391	508	2,440	252	2,275
1981-1991	3,918	632		465	
1992-2001	9,423	966	5,310	540	3,453

Source: Mills 1982-1994; Howe et al. 1995 and 1996, 2001a-d; Walker et al. 2003; Jennings et al. *In prep.*

^a Effort is angler-days for all species.

^b Unpublished.

In addition to the SWHS, there have been several onsite surveys of the Alagnak chinook and coho salmon fisheries. These surveys were conducted to gather fishery information not available from the SWHS. The chinook salmon fishery was first surveyed onsite in 1988 (Brookover 1989) and then again in 1989 (Dunaway 1990). In 1993, an onsite fisheries study addressed both the chinook and coho salmon fisheries, and for the first time assessed angler success and harvest practices, as well as collected more detailed information on angler demographics and gear preferences (Dunaway 1994). Due to limited funds in 1998, the Alaska Department of Fish and Game (ADF&G) was only able to study the chinook salmon fishery. In the 1998 study, angler effort was indexed, catch and harvest rates were estimated, angler demographics and tackle selection were characterized, and biological samples were collected from the sport harvest (Naughton and Gryska 2000).

At one time, sport fisheries for Alagnak River salmon occurred primarily in the lower 12 miles of the river, but with increasing effort they have expanded to include the lower 25 miles of the river. The potential impacts to chinook and coho salmon stocks by the expanding sport fishery in the lower reaches of the Alagnak River have been a source of concern to resource managers, local residents and members of the sport fishing industry for some time. During the 1998 creel survey these concerns became especially apparent.

In Bristol Bay Native Association's (BBNA) spring 2000 information needs assessment project (BBNA 2000), Levelock and nearby villages identified concerns for the Alagnak River, including the need for assessing harvest of freshwater fish, need for a creel survey of the sport fishery, and need for assessment of salmon escapements. The National Park Service (NPS) has expressed similar concerns because most of the upper section of the river is designated a Wild River.

Sport Fish Division shares these concerns, especially given that the 1999 and 2000 spawning escapements for the Alagnak River were half the long-term average (Table 2; Sands et al. 2001). However, the fishery has expanded to more of the river than ADF&G can afford to monitor with designs of previous studies. During the summer of 2000, a project to index angler effort was funded by the U.S. Fish and Wildlife Service, Office of Subsistence Management (OSM), and conducted jointly by the Katmai National Park and the Bristol Bay Native Association. Preliminary data from the effort index were used in part to develop this 2-year project that was funded by OSM.

OBJECTIVES

Objectives for the 2001-2002 study were to:

1. Estimate angling effort in the lower 15 miles of the Alagnak River for each fishery, sport catch and harvest of chinook salmon from 25 June-31 July, and sport catch and harvest of coho salmon from 1-28 August.
2. Estimate the distribution of harvest and catch success in the lower 15 miles of the Alagnak River of chinook salmon from 25 June-31 July and of coho salmon from 1-28 August.
3. Estimate the composition of angler-days by gear and angler type in the lower 15 miles of the Alagnak River during the chinook salmon fishery from 25 June-31 July and the coho salmon fishery from 1-28 August.
4. Estimate the proportion by age, sex, and length groups in the lower 15 miles of the Alagnak River of chinook salmon harvested from 25 June-31 July and of coho salmon harvested from 1-28 August.
5. Index angler effort between mile 15 and mile 25 on the Alagnak River during the chinook salmon fishery from 25 June-31 July and the coho salmon fishery from 1-28 August.

Table 2.-Unexpanded escapement counts of chinook salmon in the Alagnak River, 1970 to 2001.

Year	Index Count ^a
1970	5,250
1971	1,475
1972	2,256
1973	824
1974	1,596
1975	6,620
1976	7,593
1977	9,425
1978	11,650
1979	
1980	2,930
1981	2,430
1982	3,400
1983	2,980
1984	6,090
1985	3,920
1986	3,090
1987	2,420
1988	4,600
1989	3,650
1990	1,720
1991	2,531
1992	3,042
1993	10,170
1994	8,480
1995	6,860
1996	9,885
1997	15,210
1998	4,148
1999	2,178
2000	2,220
2001	5,458
1970-2001	
Avg.	4,971

^a Maximum index count from Browning et al. 2002.

METHODS

STUDY DESIGN

Creel Survey

Angler count and interview data were obtained from two areas of the Alagnak River, the lower 15 miles (lower survey area), and mile 15 to mile 25 (upper survey area; Figure 3). A stratified two-stage roving-access creel survey (Bernard et al. 1998a, b) was used to estimate sport fishing effort in angler-hours, and catch and harvest of chinook and coho salmon.

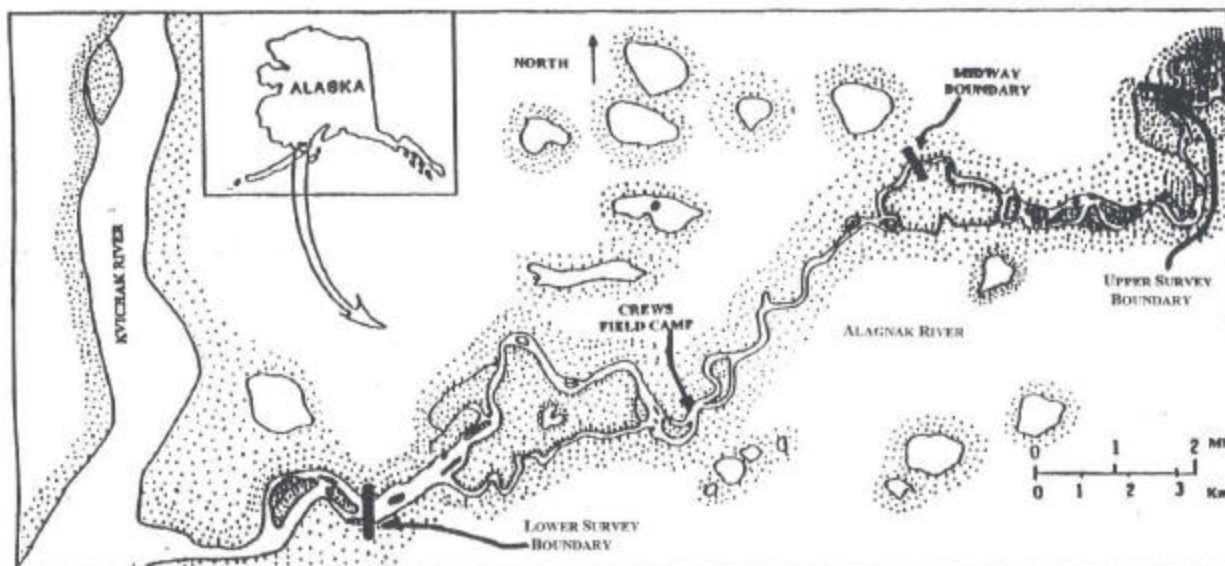


Figure 3.-Alagnak River chinook and coho salmon angler survey site.

The first stage was a 15- or 12-hour period (fishing day of the chinook or coho salmon fishery, respectively) and angler trip was the second stage. The angler day was from 0700 to 2200 hours for the chinook salmon fishery, and from 0800 to 2000 hours for the coho salmon fishery. To minimize problems with length-of-stay bias the entire fishing day was sampled (Bernard et al. 1998a, b). Length of the fishing day was determined by the amount of daylight and by the fairly routine daily operations of local lodges and fly-in operators.

Because regulations prohibit retention of chinook salmon after 31 July, the survey was stratified to estimate statistics from 25 June-31 July for the chinook salmon fishery, and from 1-28 August for the coho salmon fishery. The creel survey was further stratified into time intervals within each fishery. The chinook salmon fishery was stratified into three time intervals of 12 days each, except the last interval which was 13 days in length. The coho salmon fishery was stratified into two time intervals of 14 days each. Temporal stratification within each fishery was expected to improve precision and minimize bias associated with run timing that in turn affected angler effort, harvest and catch rates.

Seven days during the chinook salmon fishery and 8 days during the coho salmon fishery were chosen at random from each temporal stratum to be sampled. Thus, the creel survey sampled 21

(57%) of the total possible 37 days of the chinook salmon fishery and 16 (57%) of the total possible 28 days of the coho salmon fishery.

Two technicians (hereafter referred to as boat technicians) conducted angler counts from a boat. Three counts were made during each sample day. Times to begin the first count (0700, 0800, 0900, 1000, or 1100 hours during the chinook salmon fishery and 0800, 0900, 1000, or 1100 hours during the coho salmon fishery) of each day were chosen at random and all remaining counts in that day were done systematically. This resulted in an angler count occurring every 5 hours during the chinook salmon fishery and every 4 hours during the coho salmon fishery. Angler counts were considered instantaneous and reflected fishing effort at the time of the count. Both fisheries could have been accessed in four ways. Because catch and harvest rates may differ significantly among the four ways anglers access the fisheries, separate counts were conducted by access type: (1) those that access through Katmai or Branch River lodges; (2) other local lodges on the river (Alagnak and Angler Alibi lodges) or daily fly-in operators/lodges (Alaska Rainbow, Alaska Wilderness, Katmai Air/Kulik, No See Um, Valhalla, and Fishing Unlimited); (3) rafters; and (4) unguided or Lynden Air Cargo. Boat type and decals on boats made these four groups easily identifiable on the river.

Two creel technicians (hereafter referred to as access technicians) roved throughout the study area seeking completed-trip anglers to interview. Access technicians generally conducted angler interviews from 1000-1400 hours for the first shift and from 1500-2200 hours for the second shift during the chinook salmon fishery. During the coho salmon fishery the technicians conducted interviews from 0900-1300 hours for the first shift and from 1400-1900 hours for the second shift. Interviews were conducted such that the entire fishing day was sampled.

Anglers were interviewed at various lodges, airplane mooring sites used by daily fly-in operators, and other locations on the river where anglers had established picnic sites. Access technicians attempted to interview every angler leaving the fishery, but if this wasn't possible, technicians randomly selected anglers to interview from those available. Care was taken to not selectively interview only anglers who had harvested or caught fish. Anglers were likely sampled proportionally because all access locations were sampled equally and most anglers exiting at an access location that was being sampled were interviewed.

Every effort was made to interview anglers who had completed their fishing for the day (completed-trip interviews which were usually conducted at local lodges). During completed-trip interviews, anglers were asked if they had completed fishing for salmon on the Alagnak River for the day.

Other anglers who had not completed fishing for the day (incomplete-trip interviews), such as anglers associated with Katmai and Branch River lodges, were also interviewed. Due to the distance and time constraints technicians were unable to travel to Katmai and Branch River lodges to obtain complete-trip interviews. These anglers were given a voluntary angling report card. The card requested the angler to record completed-trip data including the total time fished in the lower 15 miles of the Alagnak River, the number of fish kept and released, by species, in the area on that day. The cards were numbered in a manner that allowed them to be matched up with the onsite interview data when returned. Anglers were asked to return the cards to the access technicians, to collection boxes, to their guide, or to ADF&G's King Salmon office via mail.

The success of this survey depended on obtaining enough completed-trip interviews, so it was important to maximize the number of properly completed voluntary report cards returned. Therefore the creel technicians carefully instructed and informed each angler, lodge operator, guide, and daily fly-in operator of the importance of the cards. The creel technicians were encouraged to recover as many cards as possible while remaining aware that anglers' participation was voluntary.

Using count and interview data, we estimated harvest rate (number of fish harvested per hour fished) of chinook and coho salmon, and then estimated harvest of chinook and coho salmon as the product of effort and harvest rate estimates. Catch of chinook or coho salmon (total number of fish caught, including fish released) was estimated in a similar manner using effort and catch rate estimates.

Index of Upriver Angler Effort

Boat technicians conducted angler counts to index angler effort in the upper survey area. Four of 7 days surveyed in the lower area during each temporal stratum of the chinook salmon fishery and 4 of 8 days surveyed during the coho salmon fishery were chosen at random to be sampled in the upper river. One angler count was conducted each sample day during the likely peak time of angler effort between 1100 and 1500 hours. The count began either 1 hour before (when direction of travel for angler counts was downstream) or 1 hour after (when direction of travel for angler counts was upstream) the initial lower angler count for this time frame. Counts in this area took at most 1 hour to complete.

Distribution of Angler Success and Demographics

Using completed-day interview data, we also estimated demographics of the fishery, and the distribution of harvest and catch success and composition of angler-days by terminal gear and angler type. Estimating the distribution of harvest success of chinook and coho salmon provided an evaluation of whether the daily bag limit is limiting the harvest of fish.

Biological Data

The recreational harvest of each fishery was sampled by access technicians for weight, length, and sex during angler interviews. Scale samples from chinook and coho salmon were also collected. Boat technicians also sampled harvests when not conducting angler counts.

DATA COLLECTION

Angler Counts

The direction (upstream or downstream) that the boat technicians traveled to conduct the first angler count each sample day was chosen at random. All remaining counts on the sample day were conducted with the same direction of travel. Angler counts were made as the boat was driven through the survey area to the opposite end of the survey area as quickly as safety permitted and without causing undue interference to the fishery. On days that an index count of the upriver area was scheduled, the boat technician recorded the count data separately for each river section. The trip through the lower 15 mile study area was usually accomplished in about 45 to 60 minutes. Every effort was made to ensure that the count was completed in no more than 1 hour.

During the angler count, boat technicians used multiple "tally-whackers" to count the number of anglers by access type. Upon completion of the angler count, data were recorded on Sport Fish Division Angler Count mark-sense forms Version 1.2.

Angler Interviews

Access technicians conducted angler interviews at access sites, recording the following information: (1) total time fished in the lower 15 miles of the Alagnak River to the nearest 5 minutes; (2) total harvest (number retained) by species in the lower river; and (3) total number released (not just broken off) by species. Technicians also recorded whether the interview was for a complete- or incomplete-trip; residency (local, non-local Alaska, non-Alaska U.S. resident, outside the U.S.); whether the angler was guided or unguided; angler demographics (male or female and adult or youth); the number of days the angler participated in the fishery, and gear type (terminal tackle type). All data were recorded on Sport Fish Division Angler Interview mark-sense forms Version 1.1.

When the boat technicians were not conducting angler counts, they also conducted incomplete-trip interviews of anglers associated with Katmai or Branch River lodges.

Biological Data

Access technicians, and boat technicians as time allowed, sampled as many harvested chinook and coho salmon as possible. Chinook and coho salmon were sampled for length by measuring from mid-eye to fork-of-tail to the nearest 1 mm. Chinook salmon were weighed to the nearest 0.1 kilogram and all other species of fish were weighed to the nearest 10 grams. Sex was identified by observing gonads when possible. A minimum of three scales was taken from the left side of the body of each sampled fish, at a point diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin, two rows above the lateral line (Welanders 1940; Scarnecchia 1979), and placed on an adhesive-coated card. All biological data collected from harvested fish were recorded on Sport Fish Division Age-Weight-Length mark-sense data forms.

DATA ANALYSIS

Angler Effort

For each stratum h , total angler effort (in hours) and its variance for each sampled day i were estimated as:

$$\hat{E}_{hi} = \bar{x}_{hi} T_{hi}, \text{ and} \tag{1}$$

$$\hat{V}[\hat{E}_{hi}] = \hat{V}[\bar{x}_{hi}] T_{hi}^2, \tag{2}$$

where \bar{x}_{hi} is the average number of anglers counted fishing, T_{hi} is the number of hours in each sampling period, and $\hat{V}[\bar{x}_{hi}]$ is the estimated variance of \bar{x}_{hi} , obtained approximately by using the successive difference formula appropriate for systematic samples (adapted from Wolter 1985, equation 7.2.4, page 251):

$$\hat{V}[\bar{x}_{hi}] \approx \frac{\sum_{j=2}^{r_{hi}} (x_{hij} - x_{hi(j-1)})^2}{2r_{hi}(r_{hi} - 1)}, \tag{3}$$

where x_{hij} is number of anglers during angler count j and r_{hi} is the number of angler counts per day.

Angler effort within each sampled day for each stratum was estimated by expanding over days:

$$\hat{E}_h = D_h \bar{E}_h, \quad (4)$$

where:

$$\bar{E}_h = \frac{\sum_{i=1}^{d_h} \hat{E}_{hi}}{d_h}, \quad (5)$$

and D_h and d_h are the number of days in the survey and the number of sampled days, respectively.

The variance of angler effort by stratum was estimated as:

$$\hat{V}[\hat{E}_h] = (1 - f_{1h}) \frac{D_h^2}{d_h} \frac{\sum_{i=1}^{d_h} (\hat{E}_{hi} - \bar{E}_h)^2}{d_h - 1} + f_{1h} \frac{D_h^2}{d_h^2} \sum_{i=1}^{d_h} \hat{V}[\hat{E}_{hi}], \quad (6)$$

where f_{1h} is the first-stage sampling fraction (d_h/D_h).

Total angler effort (across strata) and its variance were estimated as:

$$\hat{E} = \sum_{h=1}^L \hat{E}_h, \text{ and} \quad (7)$$

$$\hat{V}[\hat{E}] = \sum_{h=1}^L \hat{V}[\hat{E}_h]. \quad (8)$$

Harvest and Catch

Harvest and catch were estimated as the product of effort, from angler counts, and harvest/catch per unit effort, from angler interviews. Within day i of stratum h , estimates of mean harvest per unit effort were calculated using a jackknife procedure (Efron 1982) to reduce bias. Data from completed-trip interviews only were used, with data from angler cards first reweighted to reflect the number of cards issued rather than the number of cards returned. First, the mean harvest of angler-trips was divided by the mean length of trip to estimate the sample ratio of HPUE:

$$\overline{\text{HPUE}}_{hi} = \frac{\bar{H}_{hi}}{\bar{e}_{hi}} = \frac{\frac{\sum_{k=1}^{m_{hi}} w_{hik} H_{hik}}{\sum_{k=1}^{m_{hi}} w_{hik}}}{\frac{\sum_{k=1}^{m_{hi}} w_{hik} e_{hik}}{\sum_{k=1}^{m_{hi}} w_{hik}}} = \frac{\sum_{k=1}^{m_{hi}} w_{hik} H_{hik}}{\sum_{k=1}^{m_{hi}} w_{hik} e_{hik}}, \quad (9)$$

where H_{hik} was the harvest, by species, during an angler trip k , e_{hik} was the effort expended (in hours) during angler-trip k , and m_{hi} was the number of completed-trip interviews. The weights

w_{hik} equaled one if the data from angler trip k originated from an onsite interview or m_{hi}/m_{Rhi} if the data originated from a returned angler card, where m_{hi} was the number of cards issued during day i and m_{Rhi} was the number of cards issued during day i which were filled out correctly and returned.

Since the above estimate of mean HPUE has an inherent bias of order $1/m_{hi}$ (Cochran 1977), the jackknifed estimate of mean HPUE was calculated (Efron 1982):

$$\overline{HPUE}_{hi}^* = \frac{\sum_{k=1}^{m_{hi}} HPUE_{hik}^*}{m_{hi}}, \quad (10)$$

where:

$$HPUE_{hik}^* = \frac{\sum_{\substack{l=1 \\ l \neq k}}^{m_{hi}} w_{hil} H_{hil}}{\sum_{\substack{l=1 \\ l \neq k}}^{m_{hi}} w_{hil} e_{hil}}. \quad (11)$$

The jackknifed estimate was used to reduce the inherent bias to order $1/m_{hi}^2$ through the adjustment:

$$\overline{HPUE}_{hi}^{**} = m_{hi} \left[\overline{HPUE}_{hi} - \overline{HPUE}_{hi}^* \right] + \overline{HPUE}_{hi}^*. \quad (12)$$

The variance of $\overline{HPUE}_{hi}^{**}$ is the variance of \overline{HPUE}_{hi}^* :

$$\hat{V} \left[\overline{HPUE}_{hi}^{**} \right] = \hat{V} \left[\overline{HPUE}_{hi}^* \right] = \frac{m_{hi} - 1}{m_{hi}} \sum_{k=1}^{m_{hi}} \left[HPUE_{hik}^* - \overline{HPUE}_{hi}^* \right]^2. \quad (13)$$

Mean catch per unit effort (CPUE) was estimated using equations 9-13, after first substituting catch C_{hik} for harvest H_{hik} .

Total harvest, by species, during each sampling period of each sampled day of each stratum was estimated as the product of estimated effort and bias-corrected HPUE:

$$\hat{H}_{hi} = \hat{E}_{hi} \overline{HPUE}_{hi}^{**}, \quad (14)$$

and its variance followed Goodman (1960):

$$\hat{V} \left[\hat{H}_{hi} \right] = \hat{V} \left(\overline{HPUE}_{hi}^{**} \right) \hat{E}_{hi}^2 + \hat{V} \left(\hat{E}_{hi} \right) \overline{HPUE}_{hi}^{**2} - \hat{V} \left(\overline{HPUE}_{hi}^{**} \right) \hat{V} \left(\hat{E}_{hi} \right). \quad (15)$$

The total number of fish harvested during stratum h was estimated by expanding over days:

$$\hat{H}_h = D_h \overline{H}_h, \quad (16)$$

where:

$$\bar{H}_h = \frac{\sum_{i=1}^{d_h} \hat{H}_{hi}}{d_h}. \quad (17)$$

Its variance was estimated as:

$$\hat{V}(\hat{H}_h) = (1 - f_{1h}) \frac{D_h^2 \sum_{i=1}^{d_h} (\hat{H}_{hi} - \bar{H}_h)^2}{d_h - 1} + f_{1h} \frac{D_h^2}{d_h} \sum_{i=1}^{d_h} \hat{V}[\hat{H}_{hi}]. \quad (18)$$

Total harvest during the fishery, by species, and its variance were estimated by summing over strata:

$$\hat{H} = \sum_{h=1}^L \hat{H}_h, \text{ and} \quad (19)$$

$$\hat{V}[\hat{H}] = \sum_{h=1}^L \hat{V}[\hat{H}_h]. \quad (20)$$

Catch statistics were estimated similarly, after substituting $\overline{CPUE}_{hij}^{**}$ for $\overline{HPUE}_{hij}^{**}$ in equations 14-20.

CPUE as an Index of Angler Success

Catch per unit effort (CPUE) of anglers participating in the Alagnak River fisheries, an indicator of angler success, was estimated as follows. All interviews were used, regardless of whether the angler had completed fishing for the day.

$$\overline{CPUE}_h = \frac{\sum_{i=1}^{m_h} CPUE_{hi}}{m_h}, \quad (21)$$

where:

$$CPUE_{hi} = \frac{c_{hi}}{e_{hi}}, \quad (22)$$

c_{hi} was the number of fish caught (both kept and released) by angler i during stratum h , e_{hi} was hours fished, and m_h was the number of anglers interviewed.

Variance estimates were calculated as follows:

$$\hat{V}[\overline{CPUE}_h] = \frac{\sum_{i=1}^{m_h} (CPUE_{hi} - \overline{CPUE}_h)^2}{m_h(m_h - 1)}. \quad (23)$$

Distributions of Angler Catches and Harvests

The distribution of angler catches is defined as the proportions p_g of angler-trips in which g or more fish were caught, from $g = 1$ to the maximum number of fish caught by any one angler (g_{\max}). Additionally, p_0 is defined as the proportion of angler-trips with a catch of 0 fish (by species). These proportions and their variances were calculated, by time stratum t , from completed-trip interviews only, after first reweighting so that the angler card data reflected the number of cards issued rather than the number of cards returned:

$$\hat{p}_{gt} = \frac{\sum_{i=1}^{d_t} \sum_{k=1}^{m_{ti}} w_{tijk} y_{gtik}}{\sum_{i=1}^{d_t} \sum_{k=1}^{m_{ti}} w_{tik}}, \text{ and} \quad (24)$$

$$\hat{V}[\hat{p}_{gt}] = \frac{\hat{p}_{gt}(1 - \hat{p}_{gt})}{m_t - 1}, \quad (25)$$

where y_{gtik} is an indicator variable equaling one if angler k , interviewed during day i of time stratum t , caught g or more chinook or coho salmon, or 0 otherwise. The weights w_{tijk} equaled one if the data from angler trip k originated from an onsite interview or m_{ti}/m_{Rti} if the data originated from a returned angler card, where m_{ti} was the number of cards issued during day i and m_{Rti} was the number of cards issued during day i which were filled out correctly and returned. The stratum sample size m_t was the total number of completed-trip interviews within each time stratum:

$$m_t = \sum_{i=1}^{d_t} m_{ti}, \quad (26)$$

where m_{ti} equals the number of completed-trip interviews during each day in stratum t .

Angler Characteristics

The proportion of angler-trips by residency, terminal tackle type (flies or lures), angler type (guided or unguided), and demographic category was estimated by:

$$\hat{p}_b = \frac{n_b}{n}, \quad (27)$$

where:

- n_b = the number of anglers interviewed in category b , and
- n = the number of anglers interviewed.

The variance of \hat{p}_b was estimated as (Scheaffer et al. 1979):

$$\hat{V}(\hat{p}_b) = \frac{\hat{p}_b(1 - \hat{p}_b)}{(n - 1)}. \quad (28)$$

Biological Data

The proportion of chinook or coho salmon in the harvest of each respective fishery by age or sex category was estimated by equations 27 and 28, where:

n_b = the number of chinook or coho salmon of age or sex category b, and

n = the number of legible scales read from chinook or coho salmon.

RESULTS

During the 2001 Alagnak River creel survey, 1,469 interviews were conducted from 25 June through 28 August. Only 593 (40%) of the original interviews were anglers that had completed their fishing trip for the day. Of the 866 voluntary report cards issued, 68% (590) were returned. Where analyses used completed and incomplete-trip interviews, 1,023 interviews were available from the chinook salmon season and 446 were available from the coho salmon season.

During the 2002 creel survey, 1,333 interviews were conducted. Only 655 (49%) of the original interviews were anglers that had completed their fishing trip for the day. Of the 678 voluntary report cards issued, 55% (373) were returned. Where analyses used completed and incomplete-trip interviews, 983 interviews were available from the chinook salmon season and 350 were available from the coho salmon season.

CHINOOK SALMON FISHERY

During the 2001 chinook salmon fishery, 437 complete-trip interviews and 586 incomplete-trip interviews were conducted. The peak angler interview day during the 2001 chinook salmon fishery was 15 July, when 89 anglers were interviewed (Appendix A1).

The 2001 total mean angler count ranged from 1.3 on 25 June to 49.7 on 15 July in the lower survey area (Appendix A1). In the upper survey area the total angler count ranged from 0 on 25 June and 26 July to 18 anglers on 9 July (Appendix A5).

During the 2002 chinook salmon fishery, 486 complete-trip interviews and 497 incomplete-trip interviews were conducted. The peak angler interview day during the 2002 chinook salmon fishery was 7 July, when 75 anglers were interviewed.

The 2002 total mean angler count ranged from 0 on 25 and 26 June to 48.0 on 13 July in the lower survey area (Appendix A2). In the upper survey area the total angler count ranged from 0 on 26 and 27 June and 11, 13, and 28 July to 11 anglers on 21 July (Appendix A5).

Angler Success

Temporal estimates of CPUE in 2001 ranged from 0.04 fish/h (SE = 0.01) to 0.15 fish/h (SE = 0.03) with an overall estimate of 0.11 fish/h (SE = 0.01; Table 3). Estimated sport fishing effort was 13,813 (SE = 1,295) angler-hours. Total estimated chinook salmon catch was 1,573 (SE = 247) fish, and estimated harvest was 522 (SE = 92) fish.

Table 3.-Catch per unit effort for the chinook salmon sport fishery in the lower Alagnak River, 25 June-31 July, 2001 and 2002.

Temporal Component	Sample Size ^a	CPUE ^b	SE	95% Confidence Interval	
				Lower	Upper
2001					
1 (25 June-6 July)	235	0.15	0.03	0.10	0.21
2 (7-18 July)	465	0.13	0.01	0.11	0.16
3 (19-31 July)	323	0.04	0.01	0.02	0.06
Entire Season	1,023	0.11	0.01	0.09	0.13
2002					
1 (25 June-6 July)	237	0.35	0.03	0.29	0.41
2 (7-18 July)	413	0.17	0.01	0.14	0.19
3 (19-31 July)	333	0.02	0.00	0.01	0.03
Entire Season	983	0.16	0.01	0.14	0.18

^a Number of anglers interviewed.

^b Number of fish caught per angler-hour of effort.

Anglers in 2001 caught at least one chinook salmon during 42% (SE = 2) of the fishing trips, and 23% (SE = 2) of those trips resulted in a harvest of at least one fish (Table 4). Only 1% (SE = 0) of anglers harvested two or more chinook salmon and only one angler reported harvesting a bag limit of three chinook salmon. The first chinook salmon harvested accounted for 94% of the total 301 chinook salmon harvested by interviewed anglers.

Temporal estimates of CPUE in 2002 ranged from 0.02 fish/h (SE = 0.00) to 0.35 fish/h (SE = 0.03) with an overall estimate of 0.16 fish/h (SE = 0.01; Table 3). Estimated sport fishing effort was 12,229 (SE = 1,096) angler-hours. Total estimated chinook salmon catch was 2,087 (SE = 364) fish, and estimated harvest was 614 (SE = 103) fish.

Anglers in 2002 caught at least one chinook salmon during 39% (SE = 2) of the fishing trips, and 26% (SE = 2) of those trips resulted in a harvest of at least one fish (Table 4). Seven percent (SE = 1) of anglers harvested two or more chinook salmon and very few anglers (1%; SE = 1) reported harvesting a bag limit of three chinook salmon. The first chinook salmon harvested accounted for 73% of the total 374 chinook salmon harvested by interviewed anglers.

Angler Characteristics

Most anglers (84%) were guided during the 2001 chinook salmon fishery (Table 5). Non-Alaskan U.S. residents comprised 86% of the anglers while only 4% were Alaskan residents. Most anglers were adults (97%), and most were males (91%). During the 2001 chinook salmon season, 56% of anglers used spin gear, 23% used fly gear, and 21% used both.

During the 2002 chinook salmon fishery, most anglers (78%) were guided (Table 5). Non-Alaskan U.S. residents comprised 84% of the anglers while only 6% were non-local Alaskan residents. Most anglers were adults (96%), and most were males (93%). During the

Table 4.-Distribution of catch and harvest during the chinook salmon sport fishery on the lower Alagnak River, 25 June-31 July, 2001 and 2002.

Number of Fish	Catch (Released + Kept)				Harvest (Kept)				
	Percent of Trips	SE	95% CI		Percent of Trips	SE	95% CI		
			Lower	Upper			Lower	Upper	
2001									
0	58	2	55	62	77	2	74	80	
1+	42	2	38	45	23	2	20	26	
2+	19	1	16	22	1	0	1	2	
3+	11	1	9	13	0	0	0	0	
4+	5	1	4	7					
5+	3	1	2	4					
6+	1	0	0	1					
2002									
0	61	2	57	64	74	2	70	77	
1+	39	2	36	43	26	2	23	30	
2+	24	2	21	28	7	1	5	9	
3+	18	2	15	21	1	1	0	2	
4+	12	1	10	15					
5+	9	1	7	11					
6+	7	1	5	8					

Notes: In 2001, total trips = 1,014; total catch = 908; total harvest = 301.
 In 2002, total trips = 982; total catch = 1,294; total harvest = 374.

2002 chinook salmon season, 44% of anglers used spin gear, 35% used fly gear, and 21% used both.

Biological Composition

During 2001, biological data were collected from 124 harvested chinook salmon; scales were ageable for 107 of these. The biological sampling goal of 176 chinook salmon with ageable scales was not met. Most of the harvest was male (69%, SE = 5; Table 6). The predominant age groups were 1.4 (51%, SE = 5) and 1.3 (28%, SE = 4). Average length for sexes combined was 831 mm (SE = 12) and average weight was 10.4 kg (SE = 0.4). The shortest chinook salmon sampled was 313 mm (1.2 kg) and the longest was 1,022 mm (18.5 kg).

During 2002, biological data were collected from 139 harvested chinook salmon; scales were ageable for 119 of these. The biological sampling goal of 103 chinook salmon with ageable scales was met. Most of the harvest was male (76%, SE = 4; Table 7). The predominant age groups were 1.3 (35%, SE = 4) and 1.2 (29%, SE = 4). Average length for sexes combined was 741 mm (SE = 13) and average weight was 7.8 kg (SE = 0.4). The shortest chinook salmon sampled was 400 mm (1.2 kg) and the longest was 1,065 mm (15.8 kg).

Table 5.-Number and percent of angler trips by angler and gear type during the chinook salmon sport fishery on the lower Alagnak River, 25 June-31 July, 2001 and 2002.

Characteristic	2001		2002	
	Angler Trips	Percent	Angler Trips	Percent
ANGLER TYPE				
Guided	864	84	764	78
Unguided	143	14	208	21
Guide who is fishing	16	2	11	1
RESIDENCY				
Alaskan Residents				
Local Alaskan Residents ^a	0	0	8	1
Nonlocal Alaskan Residents ^b	42	4	56	6
Non-Alaskan Residents				
U.S. Resident	879	86	825	84
Non-U.S. Resident	102	10	94	10
GENDER				
Male	932	91	914	93
Female	91	9	69	7
YOUTH/ADULT				
Youth	33	3	40	4
Adult	990	97	943	96
TACKLE TYPE				
Spin	573	56	436	44
Fly	236	23	342	35
Spin and Fly	214	21	205	21
Total Angler Trips	1,023		983	

^a Alaskan resident living in Levelock and Naknek/King Salmon area.

^b All other Alaskan residents.

COHO SALMON FISHERY

In 2001, 129 complete-trip interviews and 269 incomplete-trip interviews were conducted in the lower survey area. In addition, 37 complete-trip interviews and 11 incomplete-trip interviews were conducted in the upper survey area after 16 August. The peak angler interview day during the coho salmon fishery was 4 August, when 59 anglers were interviewed in the lower area (Appendix A3).

Table 6.-Mean lengths (millimeters) and weights (kilograms) of chinook salmon, by sex and age group, from samples collected from the lower Alagnak River sport harvest, 6 June - 31 July, 2001.

Characteristic	Unknown	Age Group								Total
		1.1	1.2	1.3	1.4	1.5	2.2	2.3	2.4	
Females										
Percent				8	19	2		1	2	31
SE				3	4	1		1	1	5
Sample size				8	20	2		1	2	33
Mean length	832			849	907	882		810	906	882
SE	37			9	8	6			2	9
Sample size	6			15	20	2		1	2	39
Mean weight	9.8			11.0	12.7	11.7		8.5	11.5	11.7
SE	1.2			1.1	0.3	0.9			0.0	0.4
Sample size	6			15	20	2		1	2	39
Males										
Percent		4	7	21	32	3	1	1	2	69
SE		2	2	4	5	2	1	1	1	5
Sample size		4	7	22	34	3	1	1	2	74
Mean length	847	434	576	825	873	862	524	782	913	808
SE	41	31	27	22	16	45			9	17
Sample size	11	4	7	22	34	3	1	1	2	85
Mean weight	11.2	1.4	3.1	10.0	11.8	10.7	2.3	8.0	12.4	9.9
SE	1.6	0.3	0.5	0.8	0.6	2.1			0.6	0.5
Sample size	11	4	7	22	34	3	1	1	2	85
All Samples										
Percent		4	7	28	51	5	1	2	4	100
SE		2	2	4	5	2	1	1	2	0
Sample size		4	7	30	54	5	1	2	4	107
Mean length	842	434	576	835	886	870	524	796	909	831
SE	29	31	27	18	11	25		14	4	12
Sample size	17	4	7	30	54	5	1	2	4	124
Mean weight	10.7	1.4	3.1	10.3	12.1	11.1	2.3	8.3	12.0	10.4
SE	1.1	0.3	0.5	0.6	0.4	1.2		0.3	0.4	0.4
Sample size	17	4	7	30	54	5	1	2	4	124

The total mean angler count in 2001 ranged from 1.0 on 22, 23, and 24 August to 21.7 on 4 August in the lower survey area (Appendix A3). In the upper survey area the total angler count ranged from 0 on 2, 4, and 9 August to 9 anglers on 22 August (Appendix A5).

In 2002, 163 complete-trip interviews and 176 incomplete-trip interviews were conducted in the lower survey area. In addition, six complete-trip interviews and five incomplete-trip interviews were conducted in the upper survey area after 16 August. The peak angler interview day during the coho salmon fishery was 3 August, when 41 anglers were interviewed in the lower area (Appendix A4).

Table 7.-Mean lengths (millimeters) and weights (kilograms) of chinook salmon, by sex and age group, from samples collected from the lower Alagnak River sport harvest, 6 June-31 July, 2002.

Characteristic	Unknown	Age Group							Total
		1.1	1.2	1.3	1.4	1.5	2.2	2.3	
Females									
Percent			3	5	14	1	1	1	25
SE			1	2	3	1	1	1	4
Sample size			3	6	17	1	1	1	29
Mean length	713		730	880	872	844	845	801	845
SE	103		82	11	14				15
Sample size	2		3	6	17	1	1	1	31
Mean weight	6.2		7.5	11.3	11.2	9.5	10.8	9.5	10.4
SE	2.6		2.1	0.7	0.5				0.5
Sample size	2		3	6	17	1	1	1	31
Males									
Percent		4	27	29	12	2		2	76
SE		2	4	4	3	1		1	4
Sample size		5	32	35	14	2		2	90
Mean length	703	507	618	754	888	856		623	711
SE	33	30	22	25	34	11		15	16
Sample size	18	5	32	35	14	2		2	108
Mean weight	6.7	2.3	4.6	8.0	12.4	10.8		4.3	7.0
SE	1.0	0.4	0.6	0.7	1.1	0.1		0.3	0.4
Sample size	18	5	32	35	14	2		2	108
All Samples									
Percent		4	29	35	26	3	1	3	100
SE		2	4	4	4	1	1	1	0
Sample size		5	35	41	31	3	1	3	119
Mean length	704	507	628	772	879	852	845	682	741
SE	30	30	22	22	17	8		60	13
Sample size	20	5	35	41	31	3	1	3	139
Mean weight	6.6	2.3	4.8	8.5	11.7	10.3	10.8	6.0	7.8
SE	0.9	0.4	0.6	0.6	0.6	0.4		1.8	0.4
Sample size	20	5	35	41	31	3	1	3	139

The total mean angler count in 2002 ranged from a low of 0.3 on 26 August to a peak of 23.5 on 2 August in the lower survey area (Appendix A4). In the upper survey area the total angler count ranged from two on 7 and 26 August to 13 anglers on 16 August (Appendix A5).

Angler Success

During the 2001 coho salmon fishery, most anglers were found in the lower survey area prior to 16 August. However, after 16 August, anglers moved upriver and fishing effort shifted to the upper survey area (Table 8; Appendices A3 and A5), thus few anglers were counted or interviewed in the lower area after 16 August. Only one count per day continued to be conducted in the upper area, thus we were not able to estimate statistics based on interview data

Table 8.-Catch per unit effort for the coho salmon sport fishery in the lower Alagnak River, 1-28 August, 2001.

Temporal Component	Sample Size ^a	CPUE ^b	SE	95% Confidence Interval	
				Lower	Upper
2001					
Lower Survey Area					
1 (1-14 August)	299	0.15	0.03	0.09	0.20
2 (15-28 August)	99	0.30	0.05	0.20	0.40
Entire Season	398	0.19	0.03	0.14	0.23
Upper Survey Area					
1 (1-14 August)	0				
2 (15-28 August)	48	0.61	0.15	0.32	0.91
Entire Season	48	0.61	0.15	0.32	0.91
Areas Combined					
1 (1-14 August)	299	0.15	0.03	0.09	0.20
2 (15-28 August)	147	0.40	0.06	0.28	0.52
Entire Season	446	0.23	0.03	0.18	0.29
2002					
Lower Survey Area					
1 (1-14 August)	234	0.22	0.02	0.17	0.26
2 (15-28 August)	105	0.52	0.06	0.41	0.63
Entire Season	339	0.31	0.02	0.26	0.36
Upper Survey Area					
1 (1-14 August)	0				
2 (15-28 August)	11	0.32	0.12	0.09	0.55
Entire Season	11	0.32	0.12	0.09	0.55
Areas Combined					
1 (1-14 August)	234	0.22	0.02	0.17	0.26
2 (15-28 August)	116	0.50	0.05	0.40	0.60
Entire Season	350	0.31	0.02	0.26	0.36

^a Number of anglers interviewed.

^b Number of fish caught per angler-hour of effort

such as effort, catch and harvest. For the lower area, we estimated effort, catch and harvest for the period 1-16 August.

Estimated sport fishing effort was 3,117 (SE = 283) angler-hours in the lower survey area from 1-16 August; estimated catch was 662 (SE = 159) coho salmon; and estimated harvest was 271 (SE = 91) coho salmon. CPUE was 0.15 fish/h (SE = 0.03) for the areas combined during the first temporal component of the coho salmon fishery, and 0.40 fish/h (SE = 0.06) during the second temporal component (Table 8). CPUE for the entire fishery was 0.23 fish/h (SE = 0.03).

In the lower area from 1-16 August, anglers caught at least one coho salmon during 50% (SE = 4) of fishing trips; 28% (SE = 3) of fishing trips resulted in a harvest of at least one fish (Table 9). Nineteen percent (SE = 3) of anglers harvested two or more coho salmon and very few anglers (2%; SE = 1) reported harvesting a bag limit of three coho salmon. The first coho salmon harvested accounted for 34% of the total 176 coho salmon harvested by interviewed anglers.

Table 9.-Distribution of catch and harvest during the coho salmon sport fishery on the lower Alagnak River, 1-16 August, 2001 and 2002.

Number of Fish	Catch (Released + Kept)				Harvest (Kept)				
	Percent of Trips	SE	95% CI		Percent of Trips	SE	95% CI		
			Lower	Upper			Lower	Upper	
2001									
0	50	4	43	57	72	3	66	78	
1+	50	4	43	57	28	3	22	34	
2+	30	3	24	37	19	3	14	24	
3+ ^a	11	2	7	16	2	1	0	3	
4+	7	2	3	10					
5+	4	1	1	6					
6+	3	1	1	5					
2002									
0	38	3	32	45	60	4	53	67	
1+	62	3	55	68	40	4	33	47	
2+	43	4	36	49	8	2	4	12	
3+ ^a	32	3	26	39	0	0	0	1	
4+	22	3	16	28					
5+	17	3	12	22					
6+	15	3	10	20					

^a Number of fish harvested = 3.

During the entire 2002 coho salmon fishery, the majority of anglers were found in the lower survey area. A few anglers did move upriver after 16 August, but fishing effort was minimal in the upper survey area (Table 8; Appendices A4 and A5), thus few anglers were counted or interviewed in the upper area. Only one count per day continued to be conducted in the upper area due to the lack of fishing effort, thus we were not able to estimate effort, catch and harvest in the upper area. For the lower area, we estimated effort, catch and harvest for the period 1-28 August.

Estimated sport fishing effort was 3,781 (SE = 441) angler-hours in the lower survey area from 1-28 August; estimated catch was 904 (SE = 222) coho salmon; and estimated harvest was 201 (SE = 52) coho salmon. CPUE was 0.22 fish/h (SE = 0.02) for the areas combined during the first temporal component of the coho salmon fishery, and 0.50 fish/h (SE = 0.05) during the second temporal component (Table 8). CPUE for the entire fishery was 0.31 fish/h (SE = 0.02).

In the lower area from 1-28 August, anglers caught at least one coho salmon during 62% (SE = 3) of fishing trips; 40% (SE = 4) of fishing trips resulted in a harvest of at least one fish (Table 9). Eight percent (SE = 2) of anglers harvested two or more coho salmon and very few anglers (<1%; SE = 0) reported harvesting a bag limit of three coho salmon. The first coho salmon harvested accounted for 81% of the total 155 coho salmon harvested by interviewed anglers.

Angler Characteristics

During the 2001 coho salmon fishery, 92% of anglers were guided, 91% were non-Alaskan U.S. residents, while only 3% were non-local Alaskan residents. Most anglers were adults (91%), and most were male (91%; Table 10). During the 2001 coho salmon season, 23% of anglers used spin gear, 60% used fly gear, and 17% used both.

During the 2002 coho salmon fishery, 89% of anglers were guided, 95% were non-Alaskan U.S. residents, while only 5% were Alaskan residents. Most anglers were adults (99%), and most were male (87%; Table 10). During the 2002 coho salmon season, 25% of anglers used spin gear, 58% used fly gear, and 18% used both.

Biological Composition

During 2001, biological data were collected from 129 harvested coho salmon; ageable scales were available for 106 fish. The biological sampling goal of 145 coho salmon with ageable scales was not met. The majority of the harvest was male (72%, SE = 4; Table 11). The predominant age groups were 2.1 (53%, SE = 5), 1.2 (19%, SE = 4), and 1.1 (18%, SE = 4). Average length of sexes combined was 617 mm (SE = 3) and average weight was 4,356 g (SE = 63). The shortest coho salmon sampled was 485 mm (2,380 g) and the longest was 692 mm (6,050 g).

During 2002, biological data were collected from 99 harvested coho salmon; ageable scales were available for 83 fish. The biological sampling goal of 103 coho salmon with ageable scales was not met. The majority of the harvest was male (81%, SE = 4; Table 12). The predominant age groups were 2.1 (54%, SE = 6), 1.1 (25%, SE = 5), and 1.2 (13%, SE = 4). Average length of sexes combined was 623 mm (SE = 3) and average weight was 4,286 g (SE = 70). The shortest coho salmon sampled was 459 mm (1,700 g) and the longest was 681 mm (5,900 g).

DISCUSSION

The first survey conducted on the salmon fisheries in the lower Alagnak River was a survey of the chinook salmon fishery in 1988 (Brookover 1989). We designed the 2001 study based on the precision of those creel estimates, growth of both fisheries since 1989, and a fairly high level of stratification and sampling effort. Effort, catch and harvest estimates for 2001 attained the accuracy and precision we desired, thus the results were used to plan the 2002 survey in order to minimize bias and improve precision.

Although creel technicians could not interview every angler that fished in the study area, they likely sampled 80%-85% of all anglers participating in the fishery during each of the scheduled sampling days. On many occasions creel technicians traveled to various portions of the river and verified that little effort was occurring outside the survey boundaries.

The study design for the chinook and coho salmon sport fishery in the Alagnak River in 2001 and 2002 was more robust than previous studies (Dunaway 1990, 1994; Naughton and

Table 10.-Number and percent of angler trips by angler and gear type during the coho salmon sport fishery on the lower and upper Alagnak River, 1-28 August, 2001 and 2002.

Characteristic	2001		2002	
	Angler Trips	Percent	Angler Trips	Percent
ANGLER TYPE				
Guided	412	92	310	89
Unguided	18	4	34	10
Guide who is fishing	16	4	6	2
RESIDENCY				
Alaskan Residents				
Local Alaskan Residents ^a	3	1	0	0
Nonlocal Alaskan Residents ^b	12	3	17	5
Non-Alaskan Residents				
U.S. Resident	404	91	332	95
Non-U.S. Resident	27	6	1	0
GENDER				
Male	405	91	306	87
Female	41	9	44	13
YOUTH/ADULT				
Youth	38	9	5	1
Adult	408	91	345	99
TACKLE TYPE				
Spin	102	23	86	25
Fly	267	60	202	58
Spin and Fly	77	17	62	18
Total Angler Trips	446		350	

^a Alaskan resident living in Levelock and Naknek/King Salmon area.

^b All other Alaskan residents.

Gryska 2000); however, several statistics are comparable. These statistics include catch rates, angler characteristics, and age composition of sport harvest.

CHINOOK SALMON FISHERY

Catch per unit effort for the chinook salmon season in 2001 and 2002 was lower than observed in 1989 and 1998 (not reported in 1993). Anglers caught 0.11 and 0.16 chinook salmon/h in 2001 and 2002, respectively, whereas in 1998 CPUE was 0.20 chinook salmon/h and in 1989 CPUE was 0.18 chinook salmon/h (Table 13; Dunaway 1994; Naughton and Gryska 2000). Though the chinook salmon fishery in the Alagnak River typically peaks in mid to late July, catch rates

Table 11.-Mean lengths (millimeters) and weights (grams) of coho salmon, by sex and age group, from samples collected from the lower Alagnak River sport harvest, 7-26 August, 2001.

	Age Group							Total
	Unknown	1.1	1.2	2.1	2.2	2.3	3.1	
Females								
Percent		6	8	14	1			28
SE		2	3	3	1			4
Sample size		6	8	15	1			30
Mean length	608	615	599	619	614			612
SE	9	5	8	8				4
Sample size	9	6	8	15	1			39
Mean weight	4,294	3,803	3,843	4,143	4,470			4,073
SE	292	179	121	172				103
Sample size	9	6	8	15	1			39
Males								
Percent		12	11	39	4	3	3	72
SE		3	3	5	2	2	2	4
Sample size		13	12	41	4	3	3	76
Mean length	618	624	596	623	644	605	634	619
SE	6	5	11	6	8	17	10	3
Sample size	14	13	12	41	4	3	3	90
Mean weight	4,434	4,550	4,058	4,593	4,520	4,077	4,843	4,479
SE	150	149	280	117	85	466	106	75
Sample size	14	13	12	41	4	3	3	90
All Samples								
Percent		18	19	53	5	3	3	100
SE		4	4	5	2	2	2	0
Sample size		19	20	56	5	3	3	106
Mean length	614	621	597	622	638	605	634	617
SE	5	4	7	5	9	17	10	3
Sample size	23	19	20	56	5	3	3	129
Mean weight	4,380	4,314	3,972	4,473	4,510	4,077	4,843	4,356
SE	143	140	173	100	67	466	106	63
Sample size	23	19	20	56	5	3	3	129

were decreasing during this period in the 2001 and 2002 chinook salmon surveys (Table 3). This may have been due to a number of anglers switching from targeting chinook to chum salmon over the course of a day, as was noted by the survey technicians. Effort in angler hours as documented during an angler interview was not differentiated by species type, thus CPUE was estimated from total effort which resulted in a low CPUE estimate for chinook salmon.

The proportion of guided anglers was consistent with previous studies. Guided anglers comprised 84% of anglers interviewed on the lower Alagnak River in 2001 and 78% in 2002, compared to 82% in 1998, 83% in 1993, and 78% in 1989 (Table 13). Although spin gear was the predominant choice for anglers in the 1993, 1998, 2001, and 2002 studies, the proportions

Table 12.-Mean lengths (millimeters) and weights (grams) of coho salmon, by sex and age group, from samples collected from the lower Alagnak River sport harvest, 7-26 August, 2002.

	Age Group					Total
	Unknown	1.1	1.2	2.1	2.2	
Females						
Percent		7	2	10		19
SE		3	2	3		4
Sample size		6	2	8		16
Mean length	608	609	633	622		616
SE	9	16	8	7		6
Sample size	4	6	2	8		20
Mean weight	3,913	3,713	4,150	4,119		3,959
SE	252	287	250	146		117
Sample size	4	6	2	8		20
Males						
Percent		18	10	45	7	81
SE		4	3	6	3	4
Sample size		15	9	37	6	67
Mean length	620	630	610	626	633	625
SE	16	7	10	5	11	4
Sample size	12	15	9	37	6	79
Mean weight	4,371	4,467	4,161	4,374	4,400	4,369
SE	268	221	145	108	272	80
Sample size	12	15	9	37	6	79
All Samples						
Percent		25	13	54	7	100
SE		5	4	6	3	0
Sample size		21	11	45	6	83
Mean length	617	624	614	625	633	623
SE	12	7	9	4	11	3
Sample size	16	21	11	45	6	99
Mean weight	4,256	4,251	4,159	4,328	4,400	4,286
SE	213	190	122	93	272	70
Sample size	16	21	11	45	6	99

have changed. The percent of anglers using spinning gear decreased from 73% in 1993 and 84% in 1998 to 56% in 2001 and 44% in 2002, whereas the percent of anglers using fly gear exclusively increased from 21% in 1993 and 12% in 1998 to 23% in 2001 and 35% in 2002 (Table 13).

The age composition of chinook salmon harvested in the sport fishery was similar among the 1989, 1993, 1998, and 2001 surveys. However, the age composition of chinook salmon harvested during 2002 changed from previous studies. Age-1.3 and -1.4 chinook salmon comprised more than 80% of the sport harvest sampled in the 1989, 1993, 1998, and 2001 surveys, whereas they comprised only 61% of the harvest in 2002. Age-1.4 chinook salmon was

Table 13.-Comparison of catch rates, angler characteristics, and gear selection observed during surveys of the chinook salmon sport fishery in the lower Alagnak River in 1989, 1993, 1998, 2001, and 2002.

Statistic	Survey Year				
	1989 ^a	1993 ^b	1998 ^c	2001	2002
Survey Dates	28 June - 6 August	2 July - 3 August	2 July - 29 July	25 June - 31 July	25 June - 31 July
Total Interviews	758	2,204	1,480	1,023	983
Completed-trip Interviews	758	229	356	437	486
CPUE	0.18	Not reported	0.20	0.11	0.16
Percentage of Angler-trips					
ANGLER TYPE					
Guided	78	83	82	84	78
Unguided	22	17	13	14	21
Guide who is fishing			5	2	1
RESIDENCY					
Non-Alaskan Residents	Not reported	Not reported	92	96	93
Alaskan Residents	Not reported	Not reported	8	4	7
TACKLE TYPE					
Spin	Not reported	73	84	56	44
Fly	Not reported	21	12	23	35
Spin and Fly	Not reported	7	4	21	21

^a Dunaway 1990.

^b Dunaway 1994.

^c Naughton and Gryska 2000.

the predominant age class, 51%, 61%, and 51% of the sample in 1993, 1998, and 2001 respectively (Dunaway 1990, 1994; Naughton and Gryska 2000). In 2002, age 1.3 was the predominant age class, comprising 35% of the sample. This is likely due to an exceptionally strong parent escapement in 1997 resulting in a strong return of 1.3s in 2002.

COHO SALMON FISHERY

Though the coho salmon fishery in the Alagnak River typically peaks in mid August, catch rates increased during the final 14 days of the 2001 and 2002 coho salmon studies, primarily due to increased CPUE in the upper area (Table 8). This may have been due to a number of anglers switching from targeting chum salmon in early August to coho salmon in late August, as was noted by the survey technicians.

Prior to the 2001 and 2002 creel surveys, little emphasis had been placed on obtaining information about the coho salmon fishery. Statistics for coho salmon were not reported for the 1998 study, and the 1989 study ended on 6 August, early in the coho salmon fishery. Therefore, comparisons can only be made to the 1993 study.

The proportion of guided anglers in 2001 and 2002 was consistent with the 1993 survey. Guided anglers comprised 92% of anglers interviewed on the lower Alagnak River in 2001 and 89% in 2002, compared to 95% in 1993 (Dunaway 1994). Although fly gear was the predominant choice for anglers on the lower river in the 1993, 2001, and 2002 surveys, the proportions have changed. The percent of anglers using fly gear increased from 45% in 1993 to 60% in 2001 and 58% in 2002, whereas the percent of anglers using spin gear decreased from 43% in 1993 to 23% in 2001 and 25% in 2002.

The age composition of coho salmon harvested in the sport fishery was similar among the 1993, 2001, and 2002 surveys. Age-2.1, -1.2, and -1.1 coho salmon comprised more than 89% of the sport harvest sampled in all three surveys. Age-2.1 coho salmon was the predominant age class, comprising 75%, 53%, and 54% of the sample in 1993, 2001, and 2002, respectively.

CONCLUSIONS AND RECOMMENDATIONS

The results of the 2001 and 2002 chinook salmon surveys were very similar to the 1989, 1993, and 1998 creel surveys. The 2001 and 2002 surveys were most useful in describing the utilization of the lower Alagnak River chinook and coho salmon sport fisheries by non-resident guided anglers who either used local lodges or were flown in from another lodge for the day. These anglers tend to fish on scheduled patterns easily captured by this survey method. Only 11 local Alaskan residents were interviewed for the duration of the chinook and coho salmon surveys; this is most likely due to the remoteness of the river.

The study design used in 2002 proved to be effective for sampling this fishery. By using similar methods in future surveys, information will be more comparable and thus more useful for monitoring changes within the fishery. Periodic surveys of the Alagnak River chinook and coho salmon fishery should be continued in future years to ensure effective management of this sport fishery.

ACKNOWLEDGEMENTS

The success of this project would not have been possible without the dedication and hard work Craig Schwanke put into training technicians as well as providing them with local knowledge of the area. Creel technician Ed Lester deserves special recognition for his continued hard work and dedication in both the 2001 and 2002 surveys. In addition, Susan Klock deserves recognition for her hard work during the 2001 survey and Ethan Ford, Matt Albert, and Luke Hegg for their hard work during the 2002 survey. We are grateful for the fuel storage the late Tony Tallepalek, coordinator of Levelock Natives Ltd., provided in 2001 and Alagnak Lodge provided in 2002. A special thanks to the angling public, guides, and lodge operators for their continued support and patience during the entire survey. We would also like to thank Steve Fleischman for his guidance and help with data analysis and assistance with the statistical design and review of this project, along with Kathrin Sundet for the data handling. The U.S. Fish and Wildlife Service, Office of Subsistence Management provided \$149,600 in funding support for the project through the Fisheries Resource Monitoring Program, under agreement number 70181-1J333.

LITERATURE CITED

- ADF&G (Alaska Department of Fish and Game). 1998. 1998 Sport fishing regulations summary. Bristol Bay and Kuskokwim Bay drainages. Alaska Department of Fish and Game, Division of Sport Fish, Juneau.
- BBNA (Bristol Bay Native Association). 2000. Bristol Bay priority information needs assessment. Submitted to: The Bristol Bay Subsistence Regional Advisory Council. Bristol Bay Native Association, Dillingham Alaska. March 2000.
- Bernard, D. R., A. E. Bingham, and M. Alexandersdottir. 1998a. The mechanics of onsite creel surveys in Alaska. Alaska Department of Fish and Game, Special Publication No. 98-1, Anchorage.
- Bernard, D. R., A. E. Bingham, and M. Alexandersdottir. 1998b. Robust harvest estimates from on-site roving access creel surveys. *Transactions of the American Fisheries Society* 127:481-495.
- Brookover, T. E., III. 1989. Creel and escapement statistics for the Alagnak River during 1988. Alaska Department of Fish and Game, Fishery Data Series No. 89, Juneau.
- Browning, J., S. Morstad, T. Sands, and K. Weiland. 2002. Salmon spawning ground surveys in the Bristol Bay area, Alaska, 2001. Alaska Department of Fish and Game, Regional Information Report No 2A02-14, Anchorage.
- Cochran, W. G. 1977. Sampling techniques. Third Edition. John Wiley & Sons, New York.
- Dunaway, D. O. 1990. Creel and escapement statistics for the Alagnak River, Alaska during 1989. Alaska Department of Fish and Game, Fishery Data Series No. 90-9, Anchorage.
- Dunaway, D. O. 1994. Surveys of the chinook and coho salmon sport fisheries in the Alagnak River Alaska, 1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-24, Anchorage.
- Efron, B. 1982. The jackknife, the bootstrap and other resampling plans. CBMS-NSF Monograph, Philadelphia, PA.
- Goodman, L. A. 1960. On the exact variance of products. *Journal of the American Statistical Association* 55:708-713.
- Howe, A. L., G. Fidler, A. E. Bingham, and M. J. Mills. 1996. Harvest, catch, and participation in Alaska sport fisheries during 1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-32, Anchorage.
- Howe, A. L., G. Fidler, and M. J. Mills. 1995. Harvest, catch, and participation in Alaska sport fisheries during 1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-24, Anchorage.
- Howe, A. L., R. J. Walker, C. Olnes, K. Sundet, and A. E. Bingham. 2001a. Participation, catch, and harvest in Alaska sport fisheries during 1999. Alaska Department of Fish and Game, Fishery Data Series No. 01-8, Anchorage.
- Howe, A. L., R. J. Walker, C. Olnes, K. Sundet, and A. E. Bingham. 2001b. Revised Edition: Harvest, catch, and participation in Alaska sport fisheries during 1996. Alaska Department of Fish and Game, Fishery Data Series No. 97-29 (revised), Anchorage.
- Howe, A. L., R. J. Walker, C. Olnes, K. Sundet, and A. E. Bingham. 2001c. Revised Edition: Harvest, catch, and participation in Alaska sport fisheries during 1997. Alaska Department of Fish and Game, Fishery Data Series No. 98-25 (revised), Anchorage.
- Howe, A. L., R. J. Walker, C. Olnes, K. Sundet, and A. E. Bingham. 2001d. Revised Edition: Participation, catch, and harvest in Alaska sport fisheries during 1998. Alaska Department of Fish and Game, Fishery Data Series No. 99-41 (revised), Anchorage.
- Jennings, G. B., K. Sundet, A. E. Bingham, and H. K. Sigurdsson. In prep. Participation, catch, and harvest in Alaska sport fisheries during 2001. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.

LITERATURE CITED (Continued)

- Mills, M. J. 1982. Alaska statewide sport fish harvest studies - 1981 data. Alaska Department of Fish and Game, Federal Aid in Fish Restoration and Anadromous Fish Studies, Annual Performance Report 1981-1982, Project F-9-14, 23 (SW-I-A), Juneau.
- Mills, M. J. 1983. Alaska statewide sport fish harvest studies - 1982 data. Alaska Department of Fish and Game, Federal Aid in Fish Restoration and Anadromous Fish Studies, Annual Performance Report 1982-1983, Project F-9-15, 24 (SW-I-A), Juneau.
- Mills, M. J. 1984. Alaska statewide sport fish harvest studies - 1983 data. Alaska Department of Fish and Game, Federal Aid in Fish Restoration and Anadromous Fish Studies, Annual Performance Report 1983-1984, Project F-9-16, 25 (SW-I-A), Juneau.
- Mills, M. J. 1985. Alaska statewide sport fish harvest studies - 1984 data. Alaska Department of Fish and Game, Federal Aid in Fish Restoration and Anadromous Fish Studies, Annual Performance Report 1984-1985, Project F-9-17, 26 (SW-I-A), Juneau.
- Mills, M. J. 1986. Alaska statewide sport fish harvest studies - 1985 data. Alaska Department of Fish and Game, Federal Aid in Fish Restoration and Anadromous Fish Studies, Annual Performance Report 1985-1986, Project F-10-1, 27 (RT-2), Juneau.
- Mills, M. J. 1987. Alaska statewide sport fisheries harvest report, 1986. Alaska Department of Fish and Game, Fishery Data Series No. 2, Juneau.
- Mills, M. J. 1988. Alaska statewide sport fisheries harvest report, 1987. Alaska Department of Fish and Game, Fishery Data Series No. 52, Juneau.
- Mills, M. J. 1989. Alaska statewide sport fisheries harvest report, 1988. Alaska Department of Fish and Game, Fishery Data Series No. 122, Juneau.
- Mills, M. J. 1990. Harvest and participation in Alaska sport fisheries during 1989. Alaska Department of Fish and Game, Fishery Data Series No. 90-44, Anchorage.
- Mills, M. J. 1991. Harvest, catch, and participation in Alaska sport fisheries during 1990. Alaska Department of Fish and Game, Fishery Data Series No. 91-58, Anchorage.
- Mills, M. J. 1992. Harvest, catch, and participation in Alaska sport fisheries during 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-40, Anchorage.
- Mills, M. J. 1993. Harvest, catch, and participation in Alaska sport fisheries during 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-42, Anchorage.
- Mills, M. J. 1994. Harvest, catch, and participation in Alaska sport fisheries during 1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-28, Anchorage.
- Naughton, G. P., and A. D. Gryska. 2000. Survey of the chinook salmon sport fishery in the lower Alagnak River, Alaska, 1998. Alaska Department of Fish and Game, Fishery Data Series No. 00-26, Anchorage.
- Sands, T., J. Browning, K. A. Weiland, S. Morstad. 2001. Salmon spawning ground surveys in the Bristol Bay, Alaska, 2000. Alaska Department of Fish and Game, Regional Information Report No. 2A01-08, Anchorage.
- Scarnecchia, D. L. 1979. Variation of scale characteristics of coho salmon with sampling location on the body. *Progressive Fish Culturist* 41 (3):132-135.
- Scheaffer, R. L., W. Mendenhall, and L. Ott. 1979. *Elementary survey sampling*. Duxbury Press, North Scituate, Massachusetts.
- Walker, R. J., C. Olnes, K. Sundet, A. L. Howe, and A. E. Bingham. 2003. Participation, catch, and harvest in Alaska sport fisheries during 2000. Alaska Department of Fish and Game, Fishery Data Series No. 03-05, Anchorage.

LITERATURE CITED (Continued)

- Welander, A. D. 1940. A study of the development of the scale of chinook salmon *Oncorhynchus tshawytscha*.
Master's thesis. University of Washington, Seattle.
- Wolter, K. M. 1985. Introduction to variance estimation. Springer-Verlag, New York.

APPENDIX A. SUPPORTING DATA

Appendix A1.-Daily statistics for days sampled during the chinook salmon fishery on the lower Alagnak River, 25 June-31 July, 2001.

Temporal Stratum	Date	Angler Count		Total Anglers Interviewed	Effort		Catch		CPUE		Harvest		HPUE	
		Total	Mean		Est.	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE
1	25-Jun	4	1.3	8	20	17	0	0	0.00	0.00	0	0	0.00	0.00
1	26-Jun	22	7.3	16	110	40	13	8	0.12	0.07	6	4	0.06	0.04
1	29-Jun	10	3.3	19	50	61	2	2	0.04	0.02	1	1	0.01	0.01
1	1-Jul	35	11.7	34	175	56	10	6	0.06	0.03	1	1	0.01	0.01
1	3-Jul	48	16.0	32	240	52	24	8	0.10	0.03	8	4	0.04	0.01
1	4-Jul	56	18.7	46	280	104	51	22	0.18	0.05	16	8	0.06	0.02
1	5-Jul	75	25.0	36	375	57	75	20	0.20	0.04	40	8	0.11	0.02
1	6-Jul	55	18.3	44	275	93	49	19	0.18	0.04	14	6	0.05	0.02
2	8-Jul	85	28.3	51	425	113	63	21	0.15	0.03	14	6	0.03	0.01
2	9-Jul	82	27.3	58	410	157	94	38	0.23	0.04	24	10	0.06	0.01
2	10-Jul	81	27.0	59	405	107	119	35	0.29	0.04	19	7	0.05	0.01
2	13-Jul	88	29.3	45	440	49	14	14	0.03	0.03	14	14	0.03	0.03
2	14-Jul	144	48.0	85	720	175	69	21	0.10	0.02	26	9	0.04	0.01
2	15-Jul	149	49.7	89	745	309	111	50	0.15	0.03	27	13	0.04	0.01
2	16-Jul	133	44.3	78	665	282	70	31	0.11	0.02	39	18	0.06	0.01
3	19-Jul	148	49.3	60	740	156	112	31	0.15	0.03	44	12	0.06	0.01
3	21-Jul	88	29.3	70	440	167	19	9	0.04	0.01	5	3	0.01	0.01
3	26-Jul	36	12.0	36	180	116	0	0	0.00	0.00	0	0	0.00	0.00
3	27-Jul	91	30.3	62	455	141	8	4	0.02	0.01	3	2	0.01	0.00
3	28-Jul	58	19.3	50	290	84	6	3	0.02	0.01	0	0	0.00	0.00
3	30-Jul	40	13.3	45	200	91	0	0	0.00	0.00	0	0	0.00	0.00

Appendix A2.-Daily statistics for days sampled during the chinook salmon fishery on the lower Alagnak River, 25 June-31 July, 2002.

Temporal Stratum	Date	Angler Count		Total Anglers Interviewed	Effort		Catch		CPUE		Harvest		HPUE	
		Total	Mean		Est.	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE
1	25-Jun	0	0.0	2	0	0	0	0	0.00	0.00	0	0	0.00	0.00
1	26-Jun	0	0.0	0	0	0	0	0			0	0		
1	27-Jun	5	1.7	11	25	16	0	0	0.00	0.00	0	0	0.00	0.00
1	2-Jul	30	10.0	23	150	57	26	11	0.17	0.04	5	3	0.04	0.02
1	3-Jul	37	12.3	24	185	69	129	52	0.70	0.11	28	12	0.15	0.04
1	4-Jul	79	26.3	64	395	134	138	57	0.35	0.09	30	13	0.08	0.02
1	5-Jul	42	14.0	44	210	114	111	64	0.53	0.13	24	16	0.11	0.05
1	6-Jul	108	36.0	69	540	210	232	110	0.43	0.13	56	28	0.10	0.04
2	7-Jul	118	39.3	75	590	235	182	85	0.31	0.08	52	24	0.09	0.02
2	11-Jul	39	19.5	42	293	38	79	19	0.27	0.05	27	7	0.09	0.02
2	12-Jul	66	22.0	42	330	120	91	39	0.28	0.07	26	12	0.08	0.02
2	13-Jul	144	48.0	73	720	199	113	37	0.16	0.03	51	16	0.07	0.01
2	14-Jul	98	32.7	68	490	160	126	46	0.26	0.05	40	16	0.08	0.02
2	17-Jul	58	19.3	56	290	72	9	4	0.03	0.01	5	3	0.02	0.01
2	18-Jul	77	25.7	57	385	122	17	7	0.04	0.01	4	2	0.01	0.01
3	19-Jul	98	32.7	53	490	208	15	9	0.03	0.01	9	6	0.02	0.01
3	21-Jul	86	28.7	62	430	120	10	5	0.02	0.01	10	5	0.02	0.01
3	24-Jul	94	31.3	56	470	70	5	3	0.01	0.01	0	0	0.00	0.00
3	25-Jul	69	23.0	42	345	132	0	0	0.00	0.00	0	0	0.00	0.00
3	28-Jul	41	13.7	45	205	80	7	7	0.03	0.04	7	7	0.03	0.04
3	29-Jul	73	24.3	51	365	135	5	5	0.01	0.01	1	1	0.00	0.00
3	31-Jul	41	13.7	24	205	33	0	0	0.00	0.00	0	0	0.00	0.00

Appendix A3.-Daily statistics for days sampled during the coho salmon fishery on the lower Alagnak River, 1-28 August, 2001.

Temporal Stratum	Date	Angler Count		Total Anglers Interviewed	Effort		Catch		CPUE		Harvest		HPUE	
		Total	Mean		Est.	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE
1	2-Aug	48	16.0	35	192	59	7	5	0.03	0.02	1	1	0.01	0.01
1	3-Aug	55	18.3	40	220	64	1	1	0.00	0.00	1	1	0.00	0.00
1	4-Aug	65	21.7	59	260	98	10	5	0.04	0.01	0	0	0.00	0.00
1	8-Aug	55	18.3	42	220	12	43	17	0.20	0.08	4	3	0.02	0.01
1	9-Aug	34	11.3	28	136	64	21	11	0.15	0.04	8	5	0.06	0.03
1	11-Aug	56	18.7	44	224	72	42	18	0.19	0.06	19	8	0.08	0.03
1	13-Aug	32	10.7	23	128	21	47	16	0.37	0.11	19	7	0.15	0.05
1	14-Aug	46	15.3	28	184	20	139	54	0.75	0.28	24	7	0.13	0.04
2	15-Aug	37	12.3	34	148	20	18	10	0.12	0.06	12	11	0.08	0.07
2	16-Aug	59	19.7	33	236	98	83	34	0.35	0.02	83	34	0.35	0.02
2	19-Aug	4	1.3	9	16	14	4	4	0.28	0.14	4	4	0.25	0.12
2	20-Aug	5	1.7	16	20	17	2	2	0.10	0.05	2	2	0.10	0.05
2	22-Aug	3	1.0	11	12	10								
2	23-Aug	3	1.0	12	12	10								
2	24-Aug	3	1.0	18	12	10	4	4	0.33	0.10	0	0	0.00	0.00
2	26-Aug	10	3.3	14	40	22								

Appendix A4.-Daily statistics for days sampled during the coho salmon fishery on the lower Alagnak River, 1-28 August, 2002.

Temporal Stratum	Date	Angler Count		Total Anglers Interviewed	Effort		Catch		CPUE		Harvest		HPUE	
		Total	Mean		Est.	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE
1	1-Aug	45	15.0	31	180	70	1	1	0.00	0.01	0	0	0.00	0.00
1	2-Aug	47	23.5	37	282	138	16	11	0.06	0.03	6	5	0.02	0.02
1	3-Aug	68	22.7	41	272	38	104	64	0.38	0.23	29	11	0.11	0.04
1	7-Aug	45	15.0	20	180	33	49	22	0.27	0.11	13	7	0.07	0.04
1	9-Aug	37	12.3	23	148	21	124	74	0.84	0.49	1	1	0.01	0.01
1	10-Aug	55	18.3	28	220	197	61	56	0.28	0.12	22	20	0.10	0.02
1	12-Aug	38	12.7	25	152	74	68	52	0.44	0.30	14	8	0.10	0.03
1	13-Aug	50	16.7	29	200	73	83	41	0.42	0.15	24	10	0.12	0.03
2	16-Aug	15	5.0	16	60	41	12	9	0.21	0.06	5	3	0.08	0.02
2	17-Aug	18	6.0	17	72	10	36	9	0.51	0.11	6	2	0.08	0.03
2	18-Aug	11	5.5	13	66	66	45	45	0.68	0.17	9	9	0.13	0.04
2	20-Aug	26	8.7	20	104	54	41	25	0.39	0.15	6	4	0.06	0.02
2	21-Aug	33	11.0	18	132	8	66	13	0.50	0.09	10	4	0.07	0.03
2	24-Aug	13	4.3	16	52	22	32	17	0.61	0.24	4	3	0.08	0.05
2	25-Aug	9	3.0	11	36	15	22	12	0.60	0.26	1	1	0.02	0.03
2	26-Aug	1	0.3	5	4	3	5	5	1.36	0.25	0	0	0.00	0.00

Appendix A5.-Numbers of anglers counted in the upper area of the Alagnak River during the chinook and coho salmon fisheries, 2001 and 2002.

Chinook		Coho	
Date	Anglers Counted	Date	Anglers Counted
2001			
25-Jun	0	2-Aug	0
1-Jul	4	3-Aug	1
3-Jul	12	4-Aug	0
5-Jul	16	9-Aug	0
8-Jul	3	15-Aug	3
9-Jul	18	20-Aug	7
14-Jul	4	22-Aug	9
16-Jul	10	24-Aug	2
21-Jul	2		
26-Jul	0		
27-Jul	9		
2002			
26-Jun	0	1-Aug	4
27-Jun	0	7-Aug	2
2-Jul	1	10-Aug	6
3-Jul	2	13-Aug	4
7-Jul	2	16-Aug	13
11-Jul	0	17-Aug	5
12-Jul	3	18-Aug	9
13-Jul	0	26-Aug	2
21-Jul	11		
28-Jul	0		
29-Jul	4		
31-Jul	3		