

**Fishery Data Series No. 00-42**

---

---

**Surveys of the 1998 Chinook and the 1999 Coho  
Salmon Sport Fisheries in the lower Togiak River,  
Alaska**

by

**Andrew D. Gryska**

and

**George P. Naughton**

---

---

December 2000

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.

<b>Weights and measures (metric)</b>		<b>General</b>		<b>Mathematics, statistics, fisheries</b>
centimeter	cm	All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.	alternate hypothesis $H_A$
deciliter	dL			base of natural logarithm $e$
gram	g	All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.	catch per unit effort CPUE
hectare	ha			coefficient of variation CV
kilogram	kg	and	&	common test statistics $F, t, \chi^2$ , etc.
kilometer	km	at	@	confidence interval C.I.
liter	L	Compass directions:		correlation coefficient $R$ (multiple)
meter	m			correlation coefficient $r$ (simple)
metric ton	mt	east	E	covariance cov
milliliter	ml	north	N	degree (angular or temperature) °
millimeter	mm	south	S	degrees of freedom df
		west	W	divided by $\div$ or / (in equations)
		Copyright	©	equals =
<b>Weights and measures (English)</b>		Corporate suffixes:		expected value E
cubic feet per second	ft <sup>3</sup> /s	Company	Co.	fork length FL
foot	ft	Corporation	Corp.	greater than >
gallon	gal	Incorporated	Inc.	greater than or equal to $\geq$
inch	in	Limited	Ltd.	harvest per unit effort HPUE
mile	mi	et alii (and other people)	et al.	less than <
ounce	oz	et cetera (and so forth)	etc.	less than or equal to $\leq$
pound	lb	exempli gratia (for example)	e.g.,	logarithm (natural) ln
quart	qt	id est (that is)	i.e.,	logarithm (base 10) log
yard	yd	latitude or longitude	lat. or long.	logarithm (specify base) $\log_2$ , etc.
Spell out acre and ton.		monetary symbols (U.S.)	\$, ¢	mid-eye-to-fork MEF
		months (tables and figures): first three letters	Jan, ..., Dec	minute (angular) '
<b>Time and temperature</b>		number (before a number)	# (e.g., #10)	multiplied by x
day	d	pounds (after a number)	# (e.g., 10#)	not significant NS
degrees Celsius	°C	registered trademark	®	null hypothesis $H_0$
degrees Fahrenheit	°F	trademark	™	percent %
hour (spell out for 24-hour clock)	h	United States (adjective)	U.S.	probability P
minute	min	United States of America (noun)	USA	probability of a type I error (rejection of the null hypothesis when true) $\alpha$
second	s	U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)	probability of a type II error (acceptance of the null hypothesis when false) $\beta$
Spell out year, month, and week.				second (angular) "
<b>Physics and chemistry</b>				standard deviation SD
all atomic symbols				standard error SE
alternating current	AC			standard length SL
ampere	A			total length TL
calorie	cal			variance Var
direct current	DC			
hertz	Hz			
horsepower	hp			
hydrogen ion activity	pH			
parts per million	ppm			
parts per thousand	ppt, ‰			
volts	V			
watts	W			

***FISHERY DATA SERIES NO. 00-42***

**SURVEYS OF THE 1998 CHINOOK AND 1999 COHO SALMON SPORT  
FISHERIES IN THE LOWER TOGIAK RIVER, ALASKA**

by

Andrew D. Gyska

and

George P. Naughton,

*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

December 2000

This investigation was partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-14 and F-10-15, Job No. S-2-2.

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.

*Andrew D. Gryska and George P. Naughton,  
Alaska Department of Fish and Game, Division of Sport Fish  
P.O. Box 230, Dillingham, AK 99737-0605, USA*

*This document should be cited as:*

*Gryska, A. D., and G. P. Naughton. 2000. Surveys of the 1998 chinook and 1999 coho salmon sport fisheries in the lower Togiak River, Alaska. Alaska Department of Fish and Game, Fishery Data Series No. 00-42, Anchorage.*

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. Fairfield Drive, Suite 300, 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

	<b>Page</b>
LIST OF TABLES .....	ii
LIST OF FIGURES .....	ii
LIST OF APPENDICES .....	ii
ABSTRACT .....	1
INTRODUCTION .....	1
METHODS .....	5
Study Design .....	5
CPUE as an Index of Abundance .....	5
Angler Effort Index .....	7
Angler Characteristics .....	7
Data Collection .....	7
Angler Interviews .....	7
Angler Counts .....	8
Biological Sampling of Harvested Fish .....	8
Data Analysis .....	8
Catch Rate .....	8
Angler Effort .....	9
Angler Characteristics .....	9
Assumptions .....	9
Biological Composition .....	10
RESULTS .....	10
Chinook Salmon in 1998 .....	10
Coho Salmon in 1999 .....	11
DISCUSSION .....	11
ACKNOWLEDGMENTS .....	14
LITERATURE CITED .....	19
APPENDIX A. SUPPORTING STATISTICS .....	21
APPENDIX B. COMPUTER FILES AND SOFTWARE .....	27

## LIST OF TABLES

<b>Table</b>	<b>Page</b>
1. Escapement and commercial, subsistence, and sport harvests of chinook salmon from the Togiak River, 1969 to 1998.....	3
2. Commercial, subsistence, and sport harvests plus escapements of coho salmon from the Togiak River, 1977 to 1998.....	4
3. Catch per unit effort for the chinook salmon sport fishery in the lower Togiak River, 28 June through 23 July 1998.....	11
4. Number and percent of angler trips by angler and gear type during the chinook salmon sport fishery on the lower Togiak River, 28 June through 20 July 1998.....	12
5. Mean lengths (millimeters) and weights (kilograms) of chinook salmon, by sex and age group, from samples collected from the lower Togiak sport harvest, 28 June through 23 July 1998.....	13
6. Catch per unit effort for the coho salmon sport fishery in the lower Togiak River, 8 through 31 August 1999.....	14
7. Number and percent of angler trips by angler and gear type during the coho salmon sport fishery on the lower Togiak River, 8 through 31 August 1999.....	15
8. Mean lengths (millimeters) and weights (kilograms) of coho salmon, by sex and age group, from samples collected from the lower Togiak River sport harvest, 8 through 31 August 1999.....	16
9. Mean lengths (millimeters) and weights (kilograms) of chinook salmon, by sex and age group, from samples collected from the lower Togiak sport harvest, 21 June through 29 July 1990.....	17
10. Mean lengths (millimeters) and weights (kilograms) of coho salmon, by sex and age group, from samples collected from the lower Togiak River sport harvest, 11 August through 14 September 1989.....	18

## LIST OF FIGURES

<b>Figure</b>	<b>Page</b>
1. Popular salmon fisheries in the Southwestern Alaska Management Area.....	2
2. Togiak River and chinook and coho salmon angler survey site.....	6

## LIST OF APPENDICES

<b>Appendix</b>	<b>Page</b>
A1. Angler counts by day during the survey on the lower Togiak River, 28 June through 23 July 1998.....	22
A2. Cumulative catches (kept and released) of all species caught by interviewed anglers during the chinook salmon survey on the lower Togiak River, 28 June through 23 July 1998.....	23
A3. Angler counts by day during the survey on the lower Togiak River, 8 through 31 August 1999.....	24
A4. Cumulative catches (kept and released) of all species caught by interviewed anglers during the coho salmon survey on the lower Togiak River, 1 through 31 August 1999.....	25
B1. Data files and computer programs used to produce this report.....	28

## ABSTRACT

Surveys of the sport fishery for chinook salmon *Oncorhynchus tshawytscha* and coho salmon *O. kisutch* were conducted on the lower Togiak River in Southwest Alaska from 28 June-23 July 1998 and 8-31 August 1999, respectively. Anglers were interviewed for information on catch, effort, use of guide services and demographic characteristics. Age, sex, length and weight data were collected from chinook and coho salmon harvested by anglers.

During the chinook salmon survey 634 anglers were interviewed. The overall catch per unit effort (CPUE) of chinook salmon was 0.72 (SE = 0.03) fish/h. Most anglers were guided (84%) and not residents (94%). A slight majority of chinook anglers used spin gear (34%), followed by bait (23%), fly gear (16%) and combinations of spin and fly (19%) and spin and bait (8%). The average length of chinook salmon sampled was 819 mm (SE = 8.9) and the average weight 9.7 kg (SE = 0.3). The predominant ages were 1.4 (48%) and 1.3 (42%).

During the coho salmon survey 530 anglers were interviewed. The overall CPUE of coho salmon was 0.37 (SE = 0.03) fish/h. Most anglers were guided (95%) and non-residents (95%). The majority of coho anglers used either fly (45%) or spin gear (40%) followed by a combination of spin and fly gear (13%). The average length of coho salmon was 586 mm (SE = 4.3) and the average weight 3.7 kg (SE = 0.1). Age-2.1 fish comprised 54% of sampled fish.

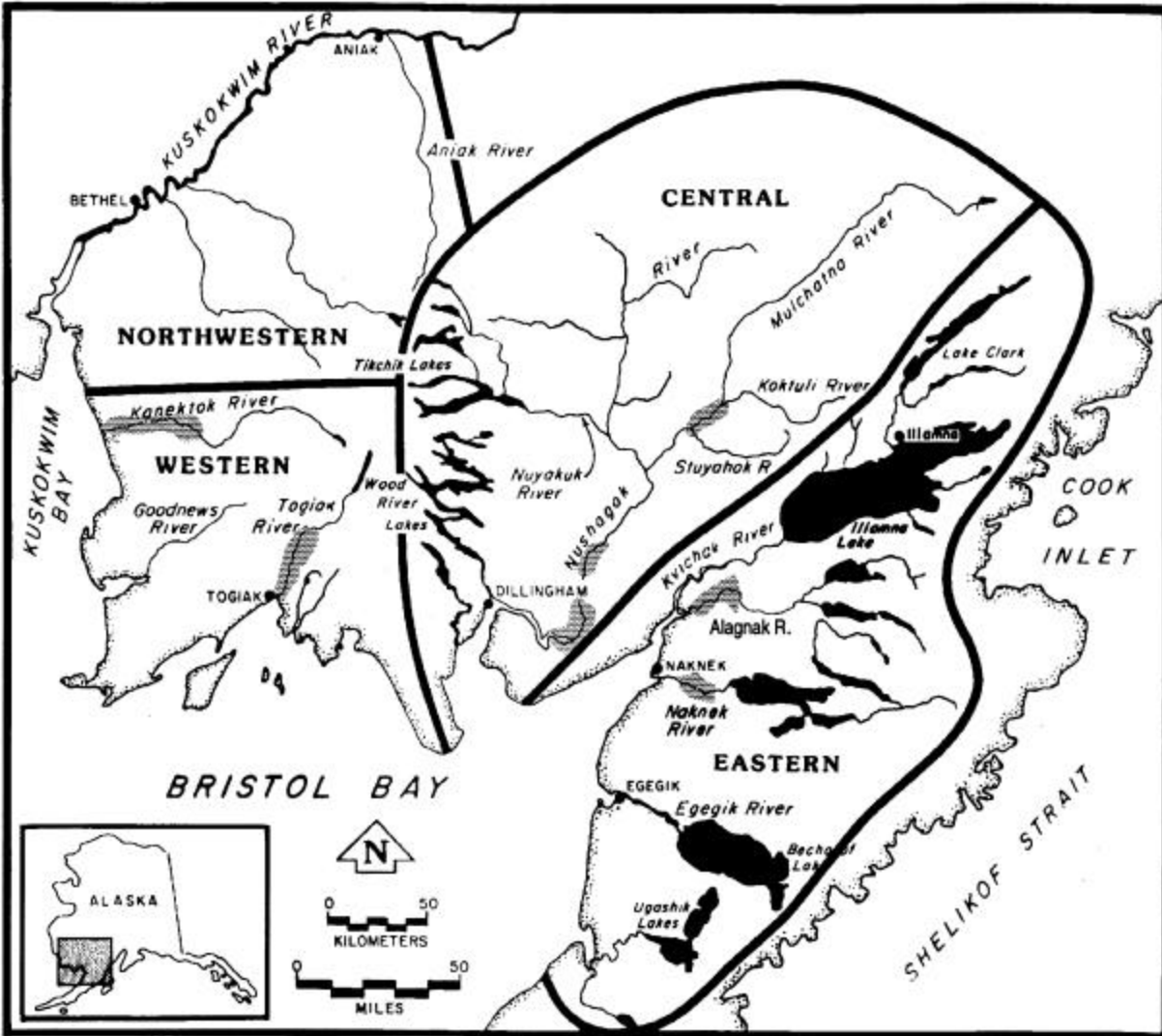
Key words: chinook salmon, *Oncorhynchus tshawytscha*, coho salmon *Oncorhynchus kisutch*, Togiak River, catch rates, angler characteristics, biological composition.

## INTRODUCTION

The Togiak River is located in Southwest Alaska (Figure 1), and flows south into Bristol Bay, about 65 miles west of Dillingham. Angling for salmon primarily occurs on the lower 12 miles of the river. As other southwest Alaska rivers have become more crowded, anglers have sought out less crowded destinations such as the Togiak River, where angling effort was 5,206 angler-days in 1998 (Howe et al. 1999, revised estimate). Harvest of chinook *Oncorhynchus tshawytscha* and coho salmon *O. kisutch* occurs in commercial, subsistence, and sport fisheries (Tables 1 and 2).

The effects of sport angling on Togiak River fish populations are a source of concern among management agencies. The U. S. Fish and Wildlife Service, which controls public use policies in the Togiak National Wildlife Refuge, is currently reviewing public use policies throughout refuge lands and may limit angling opportunities on the Togiak River in the future. Due to increasing public pressure the Board of Fisheries promulgated new sport fishing regulations, which became effective spring 1998. For chinook salmon, they were an annual bag limit of five (Bristol Bay-wide) and an open season of 1 May through 31 July instead of no closed season (ADF&G 1998). A daily bag limit of three (only two > 28 in [710 mm]) remained in effect. Currently, the coho salmon sport fishery on the Togiak River is open year-round with a daily bag and possession limit of five fish (ADF&G 1998).

To preserve angling opportunities, it is imperative to obtain baseline data and monitor the sport fisheries over time so that their characteristics and effects may be documented. Annual monitoring of major Alaskan sport fisheries, including the Togiak River, is accomplished using the department's mail survey (Mills 1979-1994, Howe et al. 1995-1999). However, more detailed information can be supplied only by onsite angler surveys. Angler surveys provide timely estimates of sport effort, catch and harvest by geographic segments of a fishery, assessments of angler characteristics and practices, and characteristics of sport-harvested fish. Angler surveys were last conducted on the Togiak chinook salmon fishery



**Figure 1.-Popular salmon fisheries in the Southwestern Alaska Management Area.**

in 1990 (Dunaway and Bingham 1991), whereas the coho salmon fishery was last surveyed in 1989 (Dunaway 1990).

The objectives for the surveys of the 1998 chinook salmon and 1999 coho salmon sport fisheries occurring in the lower Togiak River were:

1. Estimate the weekly and overall catch per unit effort (CPUE) for both fisheries;
2. Describe angler characteristics by terminal tackle type (flies, bait or lures) and angler-type (resident or nonresident; guided, unguided or guides);
3. Index daily angler effort during each sampled day; and
4. Estimate the age, sex, length and weight compositions of chinook and coho salmon harvested by the sport fishery.



**Table 1.-Escapement and commercial, subsistence, and sport harvests of chinook salmon from the Togiak River, 1969 to 1998.**

Year	Harvest				Escapement <sup>d</sup>	Total Run
	Commercial <sup>a</sup>	Subsistence <sup>b</sup>	Sport <sup>c</sup>	Total		
1969	20,092					
1970	28,618					
1971	26,105					
1972	17,099					
1973	9,225					
1974	9,284	1,200				
1975	7,206	800				
1976	28,513	500				
1977	33,827	400	62	34,289		
1978	53,460	300	35	53,795		
1979	28,677	200	78	28,955		
1980	10,858	900	34	11,792	8,045	19,837
1981	22,744	400			12,435	
1982	33,607	400	231	34,238	6,800	41,038
1983	35,669	700	535	36,904	10,975	47,879
1984	19,958	600	87	20,645	19,085	39,730
1985	33,110	600	224	33,934	12,010	45,944
1986	16,267	700	525	17,492		
1987	14,555	700	137	15,392	7,170	22,562
1988	13,212	429			6,390	
1989	9,049	551	234	9,834	6,640	16,474
1990	9,651	480	172	10,303	6,473	16,776
1991	6,019	470	284	6,773	8,380	15,153
1992	11,806	1,361	271	13,438	7,410	20,848
1993	10,054	784	225	11,063	10,210	21,273
1994	9,350	904	663	10,917	15,117	26,034
1995	10,768	448	581	11,797	12,600	24,397
1996	8,113	471	790	9,374	8,299	17,673
1997	5,357	667	1,165	7,189	10,300	17,489
All Years Avg.	18,698	624	333	19,901	9,902	26,207
Percent	94%	3%	2%			
1993 to 1997 Avg.	8,728	655	685	10,068	11,305	21,373
Percent	87%	7%	7%			
1998	12,867	782	763	14,412	9,856	24,268
Percent	89%	5%	5%			

<sup>a</sup> Togiak River Section commercial harvests. Obtained from a run of the CFD Fish Ticket Database 10/19/00. Statistical areas 326-70, 326-71, 326-72, and 326 with blank sub areas were included. All gear types, including blank and 0, were used. Harvest codes of both 0 and 11 were included. Fish retained for personal use (Delivery = 95) were excluded.

<sup>b</sup> Togiak District subsistence harvest. Sources: 1974-1978 ADF&G 1991, Appendix Table 46; 1979-1999 ADF&G 2000, Appendix Table 31.

<sup>c</sup> Source: SWHS for Togiak River System (Nushagak Area table); for 1989-1998; sources are Mills 1990-1994 and Howe et al. 1995-1999. 1996-1998 estimates presented here are the revised estimates. Estimates for 1977-1988 are unpublished.

<sup>d</sup> Togiak River drainage total, estimated by aerial survey and expanded for missed fish. Biological escapement goal is 10,000 fish.

**Table 2.-Commercial, subsistence, and sport harvests plus escapements of coho salmon from the Togiak River, 1977 to 1998.**

Year	Harvest				Escapement <sup>d</sup>	Total Run
	Commercial <sup>f</sup>	Subsistence <sup>b</sup>	Sport <sup>c</sup>	Total		
1977	33,824	1,100	114	35,038		
1978	36,959	500	214	37,673		
1979	19,201	700	300	20,201		
1980	111,829	1,200	258	113,287	65,130	178,417
1981	19,504	2,200	119	21,823	43,500	65,323
1982	108,000	1,300	524	109,824	69,900	179,724
1983	4,978	800	829	6,607		
1984	111,631	3,800	1,154	116,585	60,840	177,425
1985	35,765	1,500	0	37,265	33,210	70,475
1986	28,030	500	2,851	31,381	21,400	52,781
1987	1,284	1,600	183	3,067	16,000 <sup>e</sup>	19,067
1988	7,974	792	1,238	10,004	25,770 <sup>e</sup>	35,774
1989	35,814	976	416	37,206		
1990	2,672	1,111	367	4,150	21,390 <sup>e</sup>	25,540
1991	4,531	1,238	87	5,856	25,260	31,116
1992	4,396	1,231	251	5,878	80,100	85,978
1993	12,613	743	330	13,686		
1994	88,823	910	531	90,264		
1995	8,864	703	408	9,975		
1996	58,369	199	1,382	59,950	64,980	124,930
1997	2,776	260	780	3,816	20,625	24,441
All Years Avg.	35,135	1,113	587	36,835	42,162	82,384
Percent	95%	3%	2%			
1993-1997 Avg.	34,289	563	686	35,538	42,803	
Percent	96%	2%	2%			
1998	52,846	310	1,020	54,176	25,335	78,809
Percent	98%	1%	2%			

<sup>a</sup> Togiak River Section commercial harvests. Obtained from a run of the CFD Fish Ticket Database 10/24/00. Statistical areas 326-70, 326-71, 326-72, and 326 with blank sub areas were included. All gear types were used. Harvest codes of both 0 and 11 were included. Fish retained for personal use (Delivery = 95) were excluded.

-continued-

**Table 2.-Page 2 of 2.**

- <sup>b</sup> Togiak District subsistence harvest (includes Togiak Village and Togiak River). Sources: 1977-1979 ADF&G 1997, Appendix Table 31; 1980-1999 ADF&G 2000, Appendix Table 26.
- <sup>c</sup> Source: SWHS Mills 1979-1994; Howe et al. 1995-1999. 1996-1998 estimates presented here are the revised estimates.
- <sup>d</sup> Escapement estimates are based on fixed-wing aerial surveys. Peak counts are expanded by a factor of 3 to account for missed fish. In 1985-1987 expansion factors were greater due to incomplete surveys or poor survey conditions. Source: ADF&G 2000, Appendix Table 26. Peak aerial counts are in Glick et al. 2000, Appendix Table 31.
- <sup>e</sup> USF&WS used a sonar located 1 mile upriver from the Pungokepek River to estimate salmon returns to the Togiak River in 1987, 1988, and 1990. Estimated coho salmon escapement was 68,428; 78,589; and 28,290 fish for 1987, 1988, and 1990, respectively (Irving et al. 1995, Table 2). Sonar counts for sockeye salmon were higher than corresponding tower counts, so were apparently overestimates. Sonar counts of coho salmon are also likely overestimates.

## **METHODS**

### **STUDY DESIGN**

Systematic surveys of the chinook and coho salmon sport fisheries were conducted on the Togiak River from its confluence with the Pungokepek Creek downstream 29 km to its outlet into Togiak Bay (Figure 2). For the chinook salmon fishery, sampling occurred from 28 June-23 July 1998, 5 days per week (Sunday through Thursday), from 1000 to 1830 hours. Each day, the technician spent about 7 hours conducting angler interviews (complete and incomplete trips) and collecting biological data from sport-harvested chinook salmon encountered, and about 1.5 hours conducting the angler count. The same sampling regime occurred 8-31 August 1999 during the coho salmon survey.

The schedule for collecting interviews and conducting counts was selected to correspond to seasonal, weekly and daily peaks in the sport fishery for chinook and coho salmon as determined from previous surveys (Dunaway 1990; Dunaway and Bingham 1991) and unpublished crew leader reports. It was determined that most anglers fish for chinook during July between the hours of 1000 and 1830. To obtain a representative sample of all anglers, the sample days were selected to access weekend anglers (typically using float trips or fly-ins) and weekday anglers (characterized as using local lodges).

### **CPUE as an Index of Abundance**

This survey design and corresponding schedule were directed at obtaining a consistent proportional sample of the fishery throughout the progression of the sampled season. Accordingly, "weekly" estimates of CPUE should be unbiased as indices of abundance of salmon as they pass through the fishery (Bernard et al. 1998)<sup>1</sup>. Therefore, it is expected that the estimates of CPUE will be reflective

---

<sup>1</sup> With the proviso that catchability of the salmon remains constant throughout the course of the fishery.

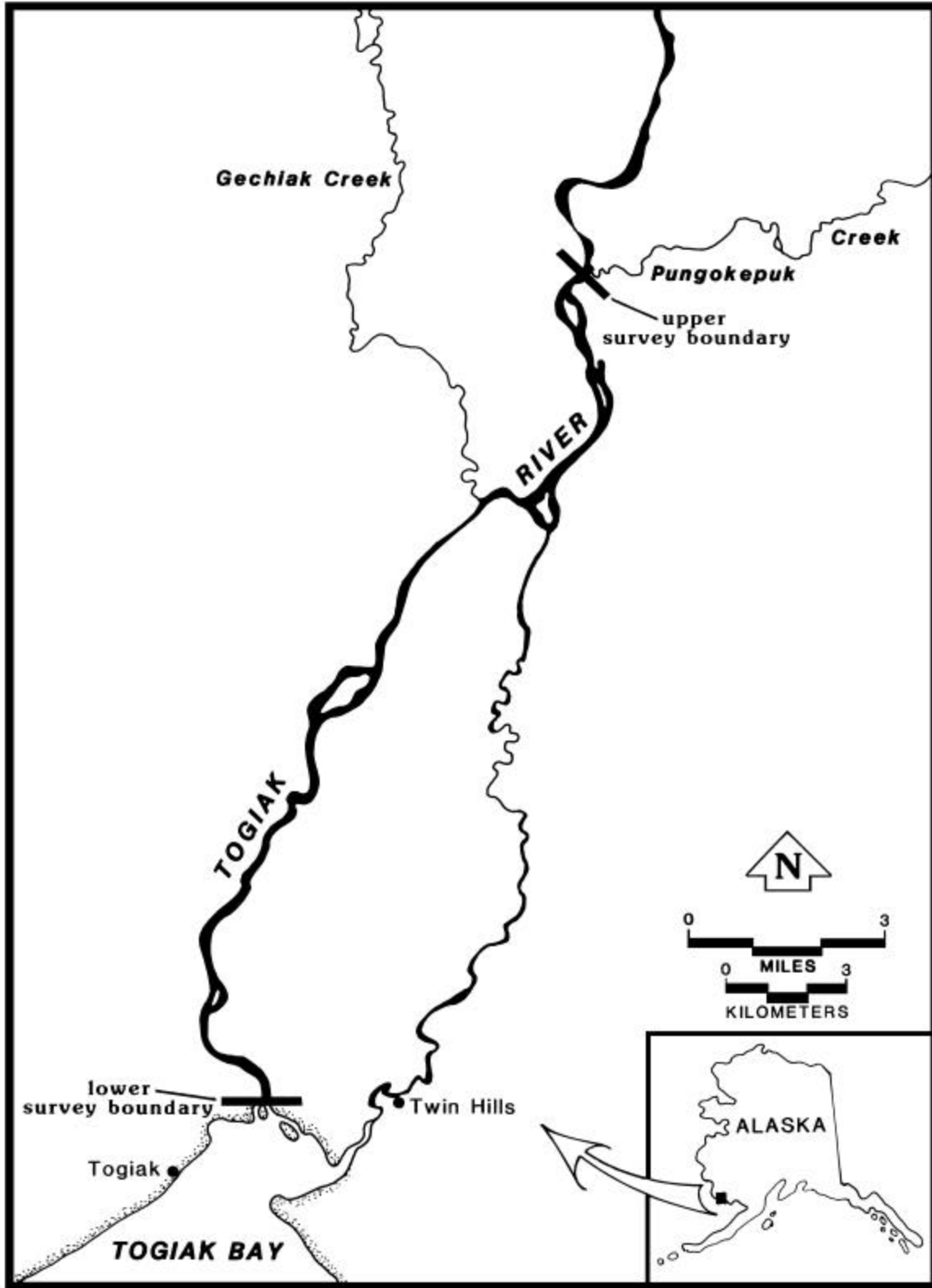


Figure 2.-Togiak River and chinook and coho salmon angler survey site.

of gross changes in fish abundance (with the usual proviso that catchability remains constant)<sup>2</sup>. However, estimates of CPUE are not expected to be unbiased estimates of the catch rate of the fishery as a whole, because not all days of the week and all hours of the angling day were sampled with equal probability.

Interviews were obtained by roving the fishery, which can result in “length of stay” (LOS) bias. The bias could be substantial because the probability of interviewing anglers is proportional to the length of their daily fishing trip. The duration of the trip can be affected by the daily bag limit, which may result in an arrest of angling when achieved. However, the likelihood of severe LOS bias and its affects are ameliorated because the Togiak River fishery is remote, which results in trips of specific duration due to travel constraints. Therefore, anglers tend to switch to catch-and-release fishing or different species after filling their bag limits. However, the estimates of CPUE may not accurately reflect overall catch rates because the entire fishing day is not covered and exit locations and methods of access are extensive.

### **Angler Effort Index**

One angler count was conducted each day at the same time. These counts will represent an unbiased index of the angler effort during the days and time sampled if the distribution of angler effort throughout the sampling day does not vary during the course of the survey. Accordingly, the count was not used to estimate angler effort for the fishery since not all possible count times were surveyed.

### **Angler Characteristics**

Since all angling days were not covered, data describing the composition of angler-trips (by terminal gear use and angler-type) were expected to be reflective of the fishery only on the sampled days and periods. If different types of anglers fish during the days of the week and/or during the hours of the day not sampled, then estimates of angler-trips by angler-type will not be representative of the whole fishery.

## **DATA COLLECTION**

### **Angler Interviews**

The technician on duty traveled (roved) throughout the fishery via motorboat to conduct interviews and count all anglers participating in the fishery. Interviews were conducted from 1000-1830 hours excluding time used for angler counts. Interviews consisted of obtaining catch, harvest, effort (time duration), angler-type (guided, unguided, guides), terminal tackle and general demographic information from anglers encountered in the fishery.

Both complete-trip (anglers who had suspended fishing for the day) and incomplete-trip interviews were collected. Technicians attempted to distribute their interview effort uniformly among all angling groups and throughout the survey area. Effort was expended to interview a high proportion (> 70%) of the anglers present on a given sampling day.

---

<sup>2</sup> Estimates of CPUE as an index of abundance may be calculated separately for anglers who use guides versus anglers who do not use guides. These two types of anglers typically exhibit substantial differences in catch rates. If the make-up of the fishery in terms of guided versus unguided anglers changes through the course of the survey, then estimates of CPUE that ignore this distinction will not accurately reflect changes of fish abundance.

## Angler Counts

A single daily angler count was used to index fishing effort. Angler counts took no more than 90 minutes, and were considered instantaneous and representative of angler effort when conducted. The starting time for the daily count was 1045 hours. The technician counted all active anglers while driving the boat at a constant rate of speed through the fishery. Active anglers were individuals who were fishing and included those handling rods and tackle, repositioning a boat, landing a fish, repairing gear or assisting another angler. Active anglers did not include people solely operating boats, eating lunch or engaging in another activities not associated with angling.

## Biological Sampling of Harvested Fish

Sport harvested chinook salmon encountered during the angler interviews were sampled for age, sex, length and weight data. When possible, all chinook retained by interviewed anglers were sampled (i.e., no subsampling of the creel). The sampling design is expected to yield a proportional sample of the harvest through the progression of the fishery (i.e., equal proportion of the harvest). The resultant data were treated as if collected from a simple random sample.

Harvested chinook and coho salmon were measured to the nearest millimeter for mid-eye to fork-of-tail length, weighed to the nearest 0.25 (chinook) or 0.1 (coho) kilograms and sexed based on external characteristics. In addition, three scales were removed from the preferred area<sup>3</sup> and mounted on an adhesive-coated card. Standard age determination procedures were used (see Jerald 1983 for a general description of the principles used). The European system of age designation was used, where the number of freshwater winter annuli precedes the decimal and the number of marine winter annuli follows. Total age from the brood year is the sum of the two numerals plus one.

## DATA ANALYSIS

### Catch Rate

Overall and weekly estimates and an overall estimate of CPUE were calculated according to the procedures outlined below. All of the individual angler interview data collected during the 5 days sampled in a week were combined to obtain these estimates. The first step involved calculating the CPUE for each angler interviewed:

$$cpue_{hi} = \frac{c_{hi}}{e_{hi}}, \quad (1)$$

where,  $c_{hi}$  equals the number of fish caught (both kept and released) by the  $i^{th}$  angler interviewed during the  $h^{th}$  week of the survey, and  $e_{hi}$  is the effort of the angler.

Then the weekly mean estimate of CPUE is simply:

$$\overline{cpue}_h = \frac{\sum_{i=1}^{m_h} cpue_{hi}}{m_h}, \quad (2)$$

---

<sup>3</sup> The left side of the fish approximately two rows above the lateral line and on a diagonal line downward from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Scarnecchia 1979 and Welander 1940).

where,  $m_h$  equals the number of anglers interviewed within each week of the survey.

Estimates of the variance of the mean CPUE estimates were calculated as follows:

$$\hat{V}[\overline{cpue}_h] = \frac{\sum_{i=1}^{m_h} (cpue_{hi} - \overline{cpue}_h)^2}{m_h(m_h - 1)}, \quad (3)$$

and SE was calculated as the square root of the variance. Confidence intervals (95%) were calculated to compare CPUE from week to week.

### **Angler Effort**

As noted above, the single angler count conducted each day represents an index of angler effort, and no analysis was performed.

### **Angler Characteristics**

The proportion of angler-trips as defined by the categories of terminal gear type use and/or angler-type (e.g., guided versus unguided) were calculated as:

$$p_z = \frac{m_z}{m}, \quad (4)$$

where  $m_z$  equals the number of the interviewed anglers whose trips are categorized as  $z$ ; and  $m$  equals the total number of classifiable anglers interviewed.

No estimates of the sampling variance were calculated, since these proportions are merely descriptive in nature and can not be used to make inferences about the fishery.

### **Assumptions**

The assumptions necessary for unbiased point and variance estimates for the various parameters obtained by the procedures outlined above include the following:

1. Interviewed anglers accurately reported their fishing time and the number of fish by species kept and released;
2. The technician accurately classified anglers and the interviewed anglers accurately reported their residency, trip type (guided, unguided), and the terminal gear type used during their fishing trip;
3. Catch rate and duration of fishing trip were independent (necessitated by the use of a roving method of interviewing—anglers with longer fishing trips have a greater probability of being intercepted for interview);
4. The distribution of angler effort within the angling day did not vary substantially during the course of the survey (necessary for CPUE to be an unbiased index of fish abundance, and for the single angler count to be an unbiased index of angler effort); and
5. Catchability of the salmon did not vary substantially during the course of the survey (necessary for CPUE to be an unbiased index of fish abundance).

There are no direct ways of evaluating or testing any of the assumptions. For assumptions 1 and 2, anglers are expected to have fairly good recollection of the total number of fish caught and to accurately report their fishing trip characteristics. Validation of assumptions 3, 4 and 5 were addressed previously (see subsection CPUE as an Index of Abundance, above).

### **Biological Composition**

The proportion of harvested chinook salmon that are age  $u$  was estimated as:

$$\hat{p}_u = \frac{n_u}{n}, \quad (5)$$

where  $n_u$  equals the number of the sampled chinook or coho salmon harvested that are age  $u$ ; and  $n$  equals the total number of chinook or coho salmon sampled.

For samples collected  $\hat{V}[\hat{p}_u]$  was calculated without the finite population correction factor, since we do not have harvest estimates:

$$\hat{V}[\hat{p}_u] = \frac{\hat{p}_u(1 - \hat{p}_u)}{n - 1}, \quad (6)$$

and SE was calculated as the square root of the variance. Mean length-at-age and mean weight of harvested chinook salmon were estimated, following standard procedures (Sokal and Rohlf 1981, Boxes 4.2 and 7.1, pages 56 and 139).

Data files and programs used to produce this report are listed in Appendix B1.

## **RESULTS**

### **CHINOOK SALMON IN 1998**

We collected CPUE data from 630 anglers in 1998. Estimates of weekly CPUE ranged from 0.41 to 1.03 fish/h (Table 3) and averaged 0.72 fish/h (SE = 0.03). Angler index counts were conducted on 17 days of the 26-day study period. Angler index counts ranged from a low of 13 on 28 June and 9 July to a high of 42 on 20 July (Appendix A1).

Angler characteristics were recorded for 634 anglers. Approximately 84% of the anglers were guided, 11% were unguided and 6% were guides who were fishing (Table 4). Most anglers were not residents of Alaska (94%) and 19% were not U.S. residents. Most anglers used spinning gear exclusively (34%), followed by bait (23%) and flies (16%). A combination of spinning and fly gear was used by 19% of the anglers and a combination of spinning tackle and bait was used by 8% of anglers.

Biological data were collected from 148 harvested chinook salmon (Table 5). Males comprised 54% (SE = 4.3) of the harvest, while females made up the other 46% (SE = 4.3). The predominant age groups among all fish sampled were age 1.4 (48.2%; SE = 4.3) and age 1.3 (41.6%; SE = 4.2). Overall average length was 819 mm (SE = 8.9) and overall average weight was 9.7 kg (SE = 0.3). The largest fish sampled was 1,028 mm long, weighed 18.6 kg and was caught on 21 July. Anglers also caught chum salmon, Dolly Varden, and rainbow trout (Appendix A2).



**Table 3.-Catch per unit effort for the chinook salmon sport fishery in the lower Togiak River, 28 June through 23 July 1998.**

Temporal Component	Sample Size	CPUE <sup>a</sup>	SE	95% Confidence Interval	
				Lower	Upper
1 (26 June-02 July)	170	0.41	0.05	0.31	0.51
2 (03-09 July)	173	0.52	0.04	0.43	0.61
3 (10-16 July)	76	1.03	0.09	0.86	1.20
4 (17-23 July)	211	1.01	0.07	0.85	1.16
Entire Season	630	0.72	0.03	0.65	0.78

<sup>a</sup> Number of fish caught per angler-hour of effort.

## COHO SALMON IN 1999

In 1999, CPUE data were collected from 530 anglers. Estimates of weekly CPUE ranged from 0.01 to 0.99 fish/h (Table 6) and averaged 0.37 fish/h (SE = 0.03). Angler index counts ranged from a low of 10 on 9 August to a high of 31 on 15, 18, 22 and 24 August (Appendix A3).

Angler characteristics were recorded for 529 anglers. Approximately 95% of the anglers were guided, while 2% were unguided and 3% were guides who were fishing (Table 7). Most anglers were not residents of Alaska (95%) and 5% were residents of another country. Most anglers used either fly fishing (45%) or spinning gear (40%). A combination of spinning and fly fishing gear was used by 13% of anglers.

Biological data were collected from 100 harvested coho salmon (Table 8). Of 81 fish aged, males comprised 80.2% (SE = 4.5), females made up 18.5% (SE = 4.3), and the sex of one (1.3%) coho salmon could not be determined. The predominant age groups among all fish sampled were age 2.1 (54.3%; SE = 5.6) followed by age 2.2 (27.2%; SE = 5.0). Overall average length was 586 mm (SE = 4.3) and overall average weight was 3.7 kg (SE = 0.1). The largest coho salmon sampled was 680 mm long, weighed 5.5 kg and was caught on 19 August. Anglers also caught chum salmon and Dolly Varden (Appendix A4).

## DISCUSSION

The chinook salmon fishery on the lower Togiak River had not been surveyed since 1990 (Dunaway and Bingham 1991), and, with respect to catch and effort, that survey was conducted and analyzed using substantially different methods than this survey. Therefore, the two surveys are not comparable. Catch rates increased from 0.5 to 1 fish/h after the first two temporal components. Most of the interviewed anglers were non-residents using local lodges or fly-in services from other lodges. The age composition of harvested chinook males during 1990 and 1998 were similar, except there were fewer age-1.2 and more 1.3- and 1.4-age males in 1998 (Tables 5 and 9). The average size of 1998

**Table 4.-Number and percent of angler trips by angler and gear type during the chinook salmon sport fishery on the lower Togiak River, 28 June through 20 July 1998.**

Characteristic	Angler Trips	Percent
<b>ANGLER TYPE</b>		
Guided	531	84
Unguided	68	11
Guide who is fishing	<u>35</u>	<u>6</u>
<b>RESIDENCY</b>		
Alaskan Residents	37	6
Local Alaskan Residents <sup>a</sup>	35	6
Nonlocal Alaskan Residents <sup>b</sup>	<u>2</u>	<u>0</u>
Non-Alaskan Residents	597	94
U.S. Resident	478	75
Non-U.S. Resident	<u>119</u>	<u>19</u>
<b>SEX</b>		
Male	604	95
Female	<u>30</u>	<u>5</u>
<b>TACKLE TYPE</b>		
Spin	214	34
Bait	144	23
Fly	103	16
Spin and Fly	120	19
Spin and Bait	<u>49</u>	<u>8</u>
Total Angler Trips	634	

<sup>a</sup> Alaskan resident living in Togiak and Twin Hills area.

<sup>b</sup> All other Alaskan residents.

**Table 5.-Mean lengths (millimeters) and weights (kilograms) of chinook salmon, by sex and age group, from samples collected from the lower Togiak sport harvest, 28 June through 23 July 1998.**

	Age Group						Total
	Unknown	1.1	1.2	1.3	1.4	1.5	
<b>Females</b>							
Percent				18	27	2	46
SE				3	4	1	4
Sample size				24	37	2	63
Mean length	845			824	863	917	849
SE	34			9	11	30	8
Sample size	5			24	37	2	68
Mean weight	10.6			9.0	11.0	14.3	10.4
SE	1.1			0.4	0.4	0.4	0.3
Sample size	5			24	37	2	68
<b>Males</b>							
Percent		4	4	24	21	2	54
SE		2	2	4	4	1	4
Sample size		5	5	33	29	2	74
Mean length	704	522	569	808	868	945	793
SE	65	34	44	11	14	27	15
Sample size	6	5	5	33	29	2	80
Mean weight	6.9	2.9	3.4	8.9	11.4	15.6	9.1
SE	1.7	0.5	0.9	0.4	0.6	2.0	0.4
Sample size	6	5	5	33	29	2	80
<b>All Samples</b>							
Percent		4	4	42	48	3	100
SE		2	2	4	4	1	
Sample size		5	5	57	66	4	137
Mean length	768	522	569	815	865	931	819
SE	43	34	44	7	9	18	9
Sample size	11	5	5	57	66	4	148
Mean weight	8.6	2.9	3.4	9.0	11.2	15.0	9.7
SE	1.2	0.5	0.9	0.3	0.3	0.9	0.3
Sample size	11	5	5	57	66	4	148

harvested fish was larger. Harvested females had a more similar age composition, but 1990 fish were slightly larger on average.

Catch rates of coho salmon from 1989 and 1999 surveys are not comparable for the same reasons as above. During 1999, the catch rate increased each week from 0.01 to 0.99, but overall the fishing was considered poor. This was no exception Bristol Bay-wide, where on 23 August an emergency order restricted daily bag limits to no more than one coho salmon per day (*Dunaway In prep*). Ages, weights

and lengths of harvested fish were similar to those harvested in 1989 (Tables 8 and 10). One exception is the 2.2-age class of which there were relatively more harvested in 1999.

For both surveys, the methodologies were most useful for characterizing the utilization of the 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. Local resident anglers tended to fish at different hours without pattern and many were never interviewed (unpublished crew reports). Though they constitute a small segment of sport anglers, they were characterized insufficiently.

These surveys documented the largest sport-angling segment (non-residents) and by using similar methods in the future we will have comparable figures to monitor use and its change over time. It is advisable to continue periodic surveys so that this important sport fishery will be well understood. With greater understanding of the fishery and its participants, the department will be more prepared to face management issues in the future.

**Table 6.-Catch per unit effort for the coho salmon sport fishery in the lower Togiak River, 8 through 31 August 1999.**

Temporal Component	Sample		95% Confidence Interval		
	Size	CPUE <sup>a</sup>	SE	Lower	Upper
1 (06-12 August)	120	0.01	0.01	0.00	0.02
2 (13-19 August)	158	0.23	0.02	0.19	0.27
3 (20-26 August)	168	0.45	0.04	0.37	0.54
4 (27-31 August)	84	0.99	0.11	0.78	1.20
Entire Season	530	0.37	0.03	0.32	0.42

<sup>a</sup> Number of fish caught per angler-hour of effort.

## ACKNOWLEDGMENTS

Execution and completion of this project would not have been possible without the hard work of field technicians Wes Jones and Jason Dye. We thank Steve Fleischman for help with the data analysis, Donna Buchholz for data handling, and USF&WS (Mark Lisac and Allen Miller) for the use of their field camp and occasional help with equipment. We also thank the angling public, guides and lodge operators for their patience and support during this survey.

**Table 7.-Number and percent of angler trips by angler and gear type during the coho salmon sport fishery on the lower Togiak River, 8 through 31 August 1999.**

Characteristic	Angler Trips	Percent
<b>ANGLER TYPE</b>		
Guided	495	95
Unguided	11	2
Guide who is fishing	16	3
<b>RESIDENCY</b>		
Alaskan Residents	28	5
Local Alaskan Residents <sup>a</sup>	11	2
Nonlocal Alaskan Residents <sup>b</sup>	17	3
Non-Alaskan Residents	494	95
U.S. Resident	468	90
Non-U.S. Resident	26	5
<b>SEX</b>		
Male	487	93
Female	35	7
<b>TACKLE TYPE</b>		
Spin	212	40
Bait	3	1
Fly	239	45
Spin and Fly	68	13
Spin and Bait	7	1
Total Angler Trips	529	

<sup>a</sup> Alaskan resident living in Togiak and Twin Hills area.

<sup>b</sup> All other Alaskan residents.

**Table 8.-Mean lengths (millimeters) and weights (kilograms) of coho salmon, by sex and age group, from samples collected from the lower Togiak River sport harvest, 8 through 31 August 1999.**

	Age Group								Total
	Unknown	1.1	1.2	2.1	2.2	2.3	3.1	3.2	
<b>Females</b>									
Percent		3		10	5			1	19
SE		2		3	2			1	4
Sample size		2		8	4			1	15
Mean length	560	561		582	538			535	563
SE	26	14		8	14				9
Sample size	6	2		8	4			1	21
Mean weight	2.9	3.3		3.4	2.7			3.1	3.1
SE	0.4	0.7		0.2	0.2				0.2
Sample size	6	2		8	4			1	21
<b>Males</b>									
Percent		5	4	44	21	1	5		80
SE		2	2	6	5	1	2		5
Sample size		4	3	36	17	1	4		65
Mean length	594	602	591	602	563	529	611		591
SE	11	17	7	7	12		10		5
Sample size	13	4	3	36	17	1	4		78
Mean weight	3.8	4.1	3.7	4.1	3.3	2.4	4.2		3.8
SE	0.2	0.3	0.2	0.2	0.3		0.6		0.1
Sample size	13	4	3	36	17	1	3		77
<b>All Samples</b>									
Percent		7	4	54	27	1	5	1	100
SE		3	2	6	5	1	2	1	
Sample size		6	3	44	22	1	4	1	81
Mean length	583	588	591	598	561	529	611	535	586
SE	11	14	7	6	10		10		4
Sample size	19	6	3	44	22	1	4	1	100
Mean weight	3.6	3.8	3.7	4.0	3.3	2.4	4.2	3.1	3.7
SE	0.2	0.3	0.2	0.1	0.2		0.6		0.1
Sample size	19	6	3	44	22	1	3	1	99

**Table 9.-Mean lengths (millimeters) and weights (kilograms) of chinook salmon, by sex and age group, from samples collected from the lower Togiak sport harvest, 21 June through 29 July 1990.**

	Unknown	Age Group					Total
		1.1	1.2	1.3	1.4	1.5	
<b>Females</b>							
Percent				3	34	4	41
SE				2	5	2	5
Sample size				2	24	3	31
Mean length	770			812	873	919	867
SE	15			43	11	34	11
Sample size	2			2	24	3	31
Mean weight	8.5			8.6	11.9	12.5	11.53
SE	1.4			1.0	0.4	1.4	0.4
Sample size	2			2	24	3	31
<b>Males</b>							
Percent		4	26	14	13	1	59
SE		2	5	4	4	1	5
Sample size		3	18	10	9	1	44
Mean length	633	374	561	619	912	998	648
SE	80	11	11	28	23		26
Sample size	3	3	18	10	9	1	44
Mean weight	4.5	0.9	3.1	4.0	12.7	16.5	5.5
SE	1.8	0.2	0.2	0.6	0.9		0.7
Sample size	3	3	18	10	9	1	44
<b>All Samples</b>							
Percent		4	26	17	47	6	100
SE		2	5	4	6	3	
Sample size		3	18	12	33	4	75
Mean length	688	374	561	651	883	939	738
SE	55	11	11	32	10	31	20
Sample size	5	3	18	12	33	4	75
Mean weight	6.1	0.9	3.1	4.8	12.1	13.5	8.0
SE	1.5	0.2	0.2	0.7	0.4	1.4	0.6
Sample size	5	3	18	12	33	4	75

**Table 10.-Mean lengths (millimeters) and weights (kilograms) of coho salmon, by sex and age group, from samples collected from the lower Togiak River sport harvest, 11 August through 14 September 1989.**

	Age Group					Total	
	Unknown	1.1	1.2	2.1	2.2		3.1
<b>Females</b>							
Percent		8		30		1	39
SE		N/A		N/A		N/A	N/A
Sample size		N/A		N/A		N/A	N/A
Mean length	625	582		601		598	598
SE	16	13		5			5
Sample size	3	11		41		1	56
Mean weight	4.2	3.8		4.0		3.8	3.9
SE	0.4	0.7		0.2			10.2
Sample size	6	2		8		1	54
<b>Males</b>							
Percent		13	2	41	3	2	60
SE		N/A	N/A	N/A	N/A	N/A	N/A
Sample size		N/A	N/A	N/A	N/A	N/A	N/A
Mean length	601	602	601	617	594	597	610
SE	17	13	36	5	34	23	4
Sample size	11	17	2	56	4	3	93
Mean weight	4.3	4.3	4.3	4.7	4.4	4.2	4.5
SE	37.1	26.3	20.0	13.5	91.4	37.6	10.87
Sample size	11	16	2	55	3	3	90
<b>All Samples</b>							
Percent		21	2	72	3	3	100
SE		N/A	N/A	N/A	N/A	N/A	N/A
Sample size		N/A	N/A	N/A	N/A	N/A	N/A
Mean length	606	594	601	610	594	597	606
SE	14	10	36	3	34	16	3
Sample size	14	28	2	98	4	4	150
Mean weight	4.3	4.1	4.3	4.4	4.4	4.1	4.3
SE	29.6	20.4	20.0	9.7	91.4	28.7	8.08
Sample size	14	27	2	95	3	4	145



## LITERATURE CITED

- ADF&G (Alaska Department of Fish and Game). 1991. Annual management report 1990, Bristol Bay Area. Division of Commercial Fisheries, Regional Information Report No. 91-1, Anchorage.
- ADF&G (Alaska Department of Fish and Game). 1997. Annual management report 1996, Bristol Bay Area. Division of Commercial Fisheries, Regional Information Report No. 2A97-14, Anchorage.
- ADF&G (Alaska Department of Fish and Game). 1998. Sport fishing regulations summary for Bristol Bay and Kuskokwim Bay drainages-1998. Juneau.
- ADF&G (Alaska Department of Fish and Game). 2000. Annual management report 1999, Bristol Bay Area. Division of Commercial Fisheries, Regional Information Report No. 2A20000-xx, Anchorage.
- Bernard, D. R., A. E. Bingham, and M. Alexandersdottir. 1998. The mechanics of conducting on-site creel surveys in Alaska. Alaska Department of Fish and Game, Special Publication No. 98-1, Anchorage.
- Dunaway, D. O. 1990. Creel and escapement statistics for the Togiak River during 1989. Alaska Department of Fish and Game, Fishery Data Series No. 90-26, Anchorage.
- Dunaway, D. O. In prep. Area management report for the recreational fisheries of the Southwest Alaska Sport Fish Management Area, 1999. Alaska Department of Fish and Game, Fishery Management Report, Anchorage.
- Dunaway D. O. and A. E. Bingham. 1991. Effort, catch, harvest and escapement statistics for the chinook salmon sport fishery in the lower Togiak River, Alaska during 1990. Alaska Department of Fish and Game, Fishery Data Series No. 91-10, Anchorage.
- Glick, B., K. A. Weiland, J. B. Browning, and S. Morstad. 2000. Salmon spawning ground surveys in the Bristol Bay area, Alaska, 1999. Alaska Department of Fish and Game, Commercial Fisheries Division, Regional Information Report No. 2A00-04, 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., 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, C. Olnes, A. E. Bingham, and M. J. Mills. 1997. Harvest, catch, and participation in Alaska sport fisheries during 1996. Alaska Department of Fish and Game, Fishery Data Series No. 97-29, Anchorage.
- Howe, A. L., G. Fidler, C. Olnes, A. E. Bingham, and M. J. Mills. 1998. Harvest, catch, and participation in Alaska sport fisheries during 1997. Alaska Department of Fish and Game, Fishery Data Series No. 98-25, Anchorage.
- Irving, D. B., J. E. Finn, and J. P. Larson. 1995. Salmon escapement estimates into the Togiak River using sonar, Togiak National Wildlife Refuge, Alaska, 1987, 1988, and 1990. U. S. Fish and Wildlife Service, Alaska Fisheries Technical Report No. 31, King Salmon, Alaska.
- Jerald, A., Jr. 1983. Age determination. Pages 301-324 in L. A. Nielsen, editors. Fisheries techniques. The American Fisheries Society, Bethesda, Maryland.
- Mills, M. J. 1979. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1978-1979, Project F-9-11, 20 (SW-1-A), Juneau.
- Mills, M. J. 1980. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1979-1980, Project F-9-12, 21 (SW-1-A), Juneau.
- Mills, M. J. 1981a. Alaska statewide sport fish harvest studies (1979). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1980-1981, Project F-9-13, 22 (SW-1-A), Juneau.

## LITERATURE CITED (Continued)

- Mills, M. J. 1981b. Alaska statewide sport fish harvest studies (1980). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1980-1981, Project F-9-13, 22 (SW-1-A), Juneau.
- Mills, M. J. 1982. Alaska statewide sport fish harvest studies (1981). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1981-1982, Project F-9-14, 23 (SW-1-A), Juneau.
- Mills, M. J. 1983. Alaska statewide sport fish harvest studies (1982). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1982-1983, Project F-9-15, 24 (SW-1-A), Juneau.
- Mills, M. J. 1984. Alaska statewide sport fish harvest studies (1983). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1983-1984, Project F-9-16, 25 (SW-1-A), Juneau.
- Mills, M. J. 1985. Alaska statewide sport fish harvest studies (1984). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1984-1985, Project F-9-17, 26 (SW-1-A), Juneau.
- Mills, M. J. 1986. Alaska statewide sport fish harvest studies (1985). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, 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.
- Scarnecchia, D. L. 1979. Variation of scale characteristics of coho salmon with sampling location on the body. *Progressive Fish Culturist* 41(3):132-135.
- Sokal, R. R. and F. J. Rohlf. 1981. *Biometry*, second edition. W. H. Freeman and Company, New York.
- Welander, A. D. 1940. A study of the development of the scale of the chinook salmon (*Oncorhynchus tshawytscha*). Master's thesis, University of Washington, Seattle.

## **APPENDIX A. SUPPORTING STATISTICS**

**Appendix A1.-Angler counts by  
day during the survey on the lower  
Togiak River, 28 June through 23  
July 1998.**

---

Date	Count
28-Jun-98	13
29-Jun-98	30
30-Jun-98	23
01-Jul-98	25
02-Jul-98	19
03-Jul-98	Scheduled off
04-Jul-98	Scheduled off
05-Jul-98	21
06-Jul-98	22
07-Jul-98	21
08-Jul-98	23
09-Jul-98	13
10-Jul-98	Scheduled off
11-Jul-98	Scheduled off
12-Jul-98	No survey
13-Jul-98	No survey
14-Jul-98	No survey
15-Jul-98	28
16-Jul-98	39
17-Jul-98	Scheduled off
18-Jul-98	Scheduled off
19-Jul-98	32
20-Jul-98	42
21-Jul-98	36
22-Jul-98	36
23-Jul-98	23

---

**Appendix A2.-Cumulative catches (kept and released) of all species caught by interviewed anglers during the chinook salmon survey on the lower Togiak River, 28 June through 23 July 1998.**

Species	Kept	Released
Chinook Salmon	289	1,935
Chum Salmon	66	530
Dolly Varden	5	114
Rainbow Trout	1	95
Sockeye Salmon	34	65
Pink Salmon	4	33
Arctic Grayling	0	3
Arctic Char	1	0
Northern Pike	0	1

**Appendix A3.-Angler counts by day during the survey on the lower Togiak River, 8 through 31 August 1999.**

---

Date	Count
08-Aug-99	11
09-Aug-99	10
10-Aug-99	16
11-Aug-99	15
12-Aug-99	12
13-Aug-99	Scheduled off
14-Aug-99	Scheduled off
15-Aug-99	31
16-Aug-99	29
17-Aug-99	28
18-Aug-99	31
19-Aug-99	18
20-Aug-99	Scheduled off
21-Aug-99	Scheduled off
22-Aug-99	31
23-Aug-99	29
24-Aug-99	31
25-Aug-99	19
26-Aug-99	18
27-Aug-99	Scheduled off
28-Aug-99	Scheduled off
29-Aug-99	17
30-Aug-99	24
31-Aug-99	29

---

**Appendix A4.-Cumulative catches (kept and released) of all species caught by interviewed anglers during the coho salmon survey on the lower Togiak River, 1 through 31 August 1999.**

Species	Kept	Released
Coho Salmon	375	551
Chum Salmon	9	669
Dolly Varden	3	142
Sockeye Salmon	7	23
Northern Pike	1	1
Rainbow Trout	0	21
Pink Salmon	0	9
Chinook Salmon	0	8
Arctic Char	0	1





## **APPENDIX B. COMPUTER FILES AND SOFTWARE**

**Appendix B1.-Data files and computer programs used to produce this report.**

---

**Data Files**

T-000301i011998.dta  
T-000301c011998.dta  
T-000301b011998.dta

Angler interview data from 28 June through 23 July 1998.  
Angler count data from 28 June through 23 July 1998.  
Togiak River chinook salmon AWL data

T-000301i011999.dta  
T-000301c011999.dta  
T-000301b011999.dta

Angler interview data from 8 through 31 August 1999.  
Angler count data from 8 through 31 August 1999.  
Togiak River coho salmon AWL data

**Analysis Programs**

BBX.SAS

A series of programs that use biological data files to produce tables of mean lengths and weights by sex and age group.

---