Fishery Data Series No. 02-16

Survey of the Rod-and-Reel Fisheries in the Aniak River, Alaska, 2001

Robert Lafferty

and

Allen E. Bingham

August 2002

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.

Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Mathematics, statistics, fisheries

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

FISHERY DATA SERIES NO. 02-16

SURVEY OF THE ROD-AND-REEL FISHERIES IN THE ANIAK RIVER, ALASKA, 2001

by

Robert Lafferty
Division of Sport Fish, Fairbanks

and

Allen E. Bingham
Division of Sport Fish, Anchorage

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

August 2002

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.

Robert Lafferty
Alaska Department of Fish and Game, Division of Sport Fish, Region III,
1300 College Road, Fairbanks, AK 99701-1599, USA
and
Allen E. Bingham
Alaska Department of Fish and Game, Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, AK 99518-1599, USA

This document should be cited as:
Lafferty, R. and A. E. Bingham. 2002. Survey of rod-and-reel fisheries in the Aniak River, Alaska, 2001. Alaska Department of Fish and Game, Fishery Data Series No. 02-16, 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

Page

LIST OF TABLES iii

LIST OF FIGURES iii

LIST OF APPENDICES iv

ANNUAL REPORT SUMMARY PAGE vi

ABSTRACT 1

INTRODUCTION 1

Background 2

OBJECTIVES AND TASKS 8

Objectives 9
Task 9

STUDY DESIGN 10

Downstream of the Buckstock River 10
Upstream of the Buckstock River 12

DATA COLLECTION 13

Angler Interviews 13
Angler Counts 13
Biological Composition 14

DATA ANALYSIS 14

Downstream of the Buckstock River 14

Angler Effort, Catch and Harvest Estimates 14
Composition Estimates 21
Assumptions 21

Upstream of the Buckstock River 22

RESULTS 22

Summary of Counts and Interviews 22

Angler Counts 22
Survey Interviews 23

Lower River Fishery Estimates 23

Angler Effort 23
Harvest and Catch 26
Angler Demographics 26
Biological Sampling 31

TABLE OF CONTENTS (Continued)

Page

DISCUSSION....32

Overview....32
Angler Demographics....32
Angler Effort....33
Harvest and Catch....33

Salmon....33
Resident Species....34

Conclusions and Recommendations....34

ACKNOWLEDGMENTS....34

LITERATURE CITED....34

APPENDIX A. SURVEY SUMMARY STATISTICS AND ESTIMATES OF HARVEST AND CATCH BY SPECIES....37

APPENDIX B. HISTORICAL SALMON ESCAPEMENT FOR THE ANIAK RIVER....49

APPENDIX C. DATA FILES AND COMPUTER PROGRAMS USED TO PRODUCE THIS REPORT....53

LIST OF TABLES

Table **Page**

1. Number of anglers, effort (angler-days), harvest, and catch of salmon in the sport fishery of the Aniak River drainage, 1989-2000. 6
2. Historical effort (angler-days), harvest and catch of resident fish species in the sport fishery of the Aniak River drainage, 1989-2000. 7
3. Summary of the number of days sampled for the lower Aniak River strata by day of week during the period from June 20 to August 31, 2001. 11
4. Survey count and interview hours for the lower Aniak River rod-and-reel survey for five systematic count combinations of three counts per sample day during the period from June 20 to August 31, 2001. 12
5. Angler counts of rod-and-reel sport and subsistence anglers in the lower Aniak River, downstream of the Buckstock River to the confluence of the Kuskokwim River, 22 June through 28 August, 2001. 15
6. Aerial survey of angler effort, boat composition and locations of the upper Aniak River, upstream of Buckstock River, during June 25-August 26, 2001. 24
7. Angler effort in angler-hours and angler-days, standard errors, relative precision, and 80% confidence intervals for the rod-and-reel fishery downstream of the Buckstock River in the Aniak River between 22 June and 28 August, 2001. 25
8. Harvest and catch of salmon and resident fish species, standard errors, relative precision, and 80% confidence intervals for the rod-and-reel fishery downstream of the Buckstock River in the Aniak River between 22 June and 28 August, 2001. 27
9. Harvest and catch of salmon and resident fish species, standard errors, relative precision, and 80% confidence intervals for the rod-and-reel fishery downstream of Doestock Creek to the mouth of the Kuskokwim River in the Aniak River between 22 June and 28 August, 2001. 28
10. Harvest and catch of salmon and resident fish species, standard errors, relative precision, and 80% confidence intervals for the rod-and-reel fishery between Buckstock River and Doestock Creek in the Aniak River between 22 June and 28 August, 2001. 29
11. Percentages of angler demographics observed downstream of the Buckstock River during the Aniak River rod-and-reel survey 22 June through 28 August 2001. 30
12. Mean mid-eye to fork lengths of coho salmon, by sex and age group, from the sport fishery in the Aniak River 22 June through 28 August 2001. 31

LIST OF FIGURES

Figure **Page**

1. The lower Kuskokwim tributaries, including the Aniak River. 3
2. Aniak River drainage. 4

LIST OF APPENDICES

Appendix **Page**

A1. Survey summary statistics and estimates of effort (angler-hours), harvest and catch of chinook salmon by rod-and-reel in the Aniak River, downstream of the Buckstock River, 22 June through 28 August 2001. 38
A2. Survey summary statistics and estimates of effort (angler-hours), harvest and catch of coho salmon by rod-and-reel in the Aniak River, downstream of the Buckstock River, 22 June through 28 August 2001. 39
A3. Survey summary statistics and estimates of effort (angler-hours), harvest and catch of chum salmon by rod-and-reel in the Aniak River, downstream of the Buckstock River, downstream of the Buckstock River, 22 June through 28 August 2001. 40
A4. Survey summary statistics and estimates of effort (angler-hours), harvest and catch of sockeye salmon by rod-and-reel in the Aniak River, downstream of the Buckstock River, downstream of the Buckstock River, 22 June through 28 August 2001. 41
A5. Survey summary statistics and estimates of effort (angler-hours), harvest and catch of pink salmon by rod-and-reel in the Aniak River, downstream of the Buckstock River, downstream of the Buckstock River, 22 June through 28 August 2001. 42
A6. Survey summary statistics and estimates of effort (angler-hours), harvest and catch of rainbow trout by rod-and-reel in the Aniak River, downstream of the Buckstock River, 22 June through 28 August 2001. 43
A7. Survey summary statistics and estimates of effort (angler-hours), harvest and catch of Dolly Varden by rod-and-reel in the Aniak River, downstream of the Buckstock River, 22 June through 28 August 2001. 44
A8. Survey summary statistics and estimates of effort (angler-hours), harvest and catch of Arctic grayling by rod-and-reel in the Aniak River, downstream of the Buckstock River, 22 June through 28 August 2001. 45
A9. Survey summary statistics and estimates of effort (angler-hours), harvest and catch of northern pike by rod-and-reel in the Aniak River, downstream of the Buckstock River, 22 June through 28 August 2001. 46
A10. Survey summary statistics and estimates of effort (angler-hours), harvest and catch of sheefish by rod-and-reel in the Aniak River, downstream of the Buckstock River, 22 June through 28 August 2001. 47
B1. Sonar counts of chum salmon passage in the Aniak River, 2001 50
B2. Historic salmon escapement estimates from the Aniak River sonar project, 1980-2001 51
B3. History of aerial survey index counts of chinook salmon in the Aniak River drainage, 1975-2001 52
C1. Data files and computer programs used to produce this report 54

Annual Report Summary

Title: Survey of the Rod-and-Reel Fisheries in the Aniak River, Alaska, 2001

Study Number: FIS 01-14

Investigator(s)/Affiliation(s): Robert Lafferty and Allen E. Bingham, Alaska Department of Fish and Game, Division of Sport Fish.

Management Regions: Region 5 (Kuskokwim)

Information Type: Harvest Monitoring

Issue(s) Addressed: To investigate concerns of local subsistence users regarding the growth in the Aniak River sport fishery, the lack of stock specific information and declining salmon returns. A roving survey was conducted to estimate the effort, catch and harvest in the rod and reel fishery of the lower Aniak River. Comparisons of inseason survey estimates and estimates from the Sport Fish Division's annual postal statewide survey are discussed.

Study Cost: $113,700

Study Duration: 22 June through 28 August, 2001

Key Words: Chinook salmon *Oncorhynchus tshawytscha*, coho salmon *Oncorhynchus kisutch*, chum salmon *Oncorhynchus keta*, rainbow trout *Oncorhynchus mykiss*, Arctic char *Salvelinus alpinus*, Dolly Varden *Salvelinus malma*, Arctic grayling *Thymallus arcticus*, sport fishing, subsistence, creel survey, angler demographics, bag limit, gear type, Aniak River, Kuskokwim River.

Citation: Lafferty, R. and A. E. Bingham. 2002. Survey of the rod-and-reel fisheries in the Aniak River, Alaska, 2001. Alaska Department of Fish and Game, Fishery Data Series No. 02-16, Anchorage.

ABSTRACT

A survey of the rod-and-reel fisheries of the Aniak River was conducted downstream of the Buckstock River and angler effort was monitored weekly upstream of Buckstock River by aerial survey during 22 June through 28 August, 2001. The rod-and-reel fisheries of the Aniak River consist both of sport fish anglers and subsistence fishers. High water conditions and federal regulations restricted use of rod-and-reel anglers in the Aniak River during 2001. A total of 114 anglers were interviewed throughout the Aniak River drainage. An estimated total of 7,789 angler-hours of effort (SE=932) were expended by anglers fishing downstream of the Buckstock River between 22 June through 28 August. Only five estimates of catch by fish species met the criteria established for precision. The largest estimated catch was for chum salmon at 5,464 fish (SE=1,424), followed by coho salmon at 4,369 fish (SE=969). The estimated catches of Dolly Varden (1,618, SE=402), Arctic grayling (1,467, SE=325) and northern pike (934, SE=185) were the only catches of resident fish species that fell within the precision criteria. All catch estimates were very similar to comparable estimates from the results for the Division of Sport Fish's annual mail survey of recreational anglers, although the magnitude of catches were somewhat below historic levels.

Key words: Chinook salmon *Oncorhynchus tshawytscha*, coho salmon *Oncorhynchus kisutch*, chum salmon *Oncorhynchus keta*, rainbow trout *Oncorhynchus mykiss*, Arctic char *Salvelinus alpinus*, Dolly Varden *Salvelinus malma*, Arctic grayling *Thymallus arcticus*, sport fishing, creel survey, angler demographics, bag limit, gear type, Aniak River, Kuskokwim River.

INTRODUCTION

The Aniak River rod-and-reel fisheries are some of the most conservatively managed remote fisheries in the State of Alaska. The Aniak River rod-and-reel fisheries are composed of both subsistence and sport anglers. In the past, estimates of effort, harvest and catch have been estimated through the mail survey of licensed sport anglers (also known as the Statewide Harvest Survey or SWHS) conducted annually by the Division of Sport Fish of the Alaska Department of Fish and Game (ADF&G). Sport fishing license requirements were rescinded in 2000 for participants in the subsistence fisheries who use rod-and-reel. Recent annual estimates of effort, harvest, and catch as measured by the SWHS are suspected to include mixtures of information involving both sport and subsistence uses. Estimates from the SWHS are often the only effort, harvest, and catch information to base management decisions and regulation development in the sport fisheries of Alaska. However, the Division of Sport Fish periodically has conducted in-season surveys to assess effort, harvest, and catch when concerns of excessive harvest arise from managers and residents. The performance of the SWHS has been regularly compared with in-season surveys around the State of Alaska. In general, in-season survey estimates are very similar with the SWHS. However, small remote sport fisheries can be very difficult to assess with reliable levels of precision. In many cases small sample sizes or low response levels to the SWHS increase the variability of estimates and uncertainty.

The level of uncertainty due to imprecise estimates from the SWHS, combined with the suspicion that estimates from the SWHS represent a mixture of subsistence and sport uses, along with the increasing public concern over rod-and-reel fishing activity in the Aniak River prompted the Division of Sport Fish and the Kuskokwim Native Association (KNA) to cooperatively design and implement a survey to estimate effort, harvest, and catch of the Aniak River rod-and-reel fishery during the summer of 2001. This harvest-monitoring project was facilitated through the local support of KNA and funding provided by the Office of Subsistence Management of the U.S. Fish and Wildlife Service.

BACKGROUND

The Aniak River is approximately 200 miles upstream of the Kuskokwim River mouth and approximately 125 miles upstream from the city of Bethel (Figure 1). In the upper third of the Aniak drainage, the Salmon and Kipchuk rivers are two major tributaries that join the Aniak River (Figure 2). These three drainages flow northward from the Kilbuck Mountains to the Kuskokwim River and converge in the upper third of the Aniak River drainage. These rivers are moderately fast flowing with considerable amounts of sweepers and log jams. The Yukon Delta Wildlife Refuge boundary includes the lower 45 miles of the Aniak River. Approximately 30 miles from the Kuskokwim confluence is the Buckstock River. Doestock Creek almost bisects the distance from Buckstock River to the Kuskokwim confluence. Doestock Creek is currently the lower demarcation for special waters where anglers are restricted to using single-hook artificial lures to protect the rainbow trout in the sport fishery.

The Aniak River is the natal stream for five species of anadromous salmon: chinook *Oncorhynchus tshawytscha*, chum *O. keta*, sockeye *O. nerka*, pink *O. gorbuscha*, and coho *O. kisutch*. Escapements of chinook salmon are assessed via aerial survey and chum salmon by sonar in the Aniak River, these assessment projects are operated by the Commercial Fisheries Division of ADF&G (Appendices B1, B2, and B3). Resident fish species inhabiting the Aniak River include: rainbow trout *O. mykiss*, Dolly Varden *Salvelinus malma*, northern pike *Esox lucius*, Arctic grayling *Thymallus arcticus*, burbot *Lota lota*, sheefish *Stenodus leucichthys*, lake trout *Salvelinus namaycush*, whitefish *Coregonus*, longnose suckers *Catostomus catostomus*, blackfish *Dallia pectoralis*, and slimy sculpin *Cottus cognatus*.

The rainbow trout stocks that reside in the Aniak River are at their northern limit of their North American distribution and are characterized as slow growing with a small size at age and not particularly abundant. This is consistent with several of the lower Kuskokwim tributaries (including the Kisaralik, Kasigluk and Kwethluk rivers). Rainbow trout management strategies have focused on conservation of wild stocks. The stocks of rainbow trout in the Aniak River were included in the Southwest Rainbow Trout Management Plan (AAC 2001a) and are managed in a conservative manner with catch-and-release practices in upper portions of the drainage. Prior to this rainbow trout management plan, bag limits were implemented in the Kuskokwim area during the mid 1980s to eliminate excessive harvests. Bag limits prior to this time were very liberal and provided opportunity for local people to meet food needs.

Growth in the sport fishery in the Aniak River combined with poor returns of chum salmon during 1993 prompted local concerns from many Aniak residents who were accustomed to subsistence fishers and few visiting anglers. The division responded to these local concerns by posting Sport Fisheries staff during 1993 in the Aniak River for 10 days observing the sport fishery and collecting biological data from rainbow trout, Arctic grayling and Dolly Varden in the middle portion of the Aniak River. This “snap shot” of the fishery provided little quantitative information.

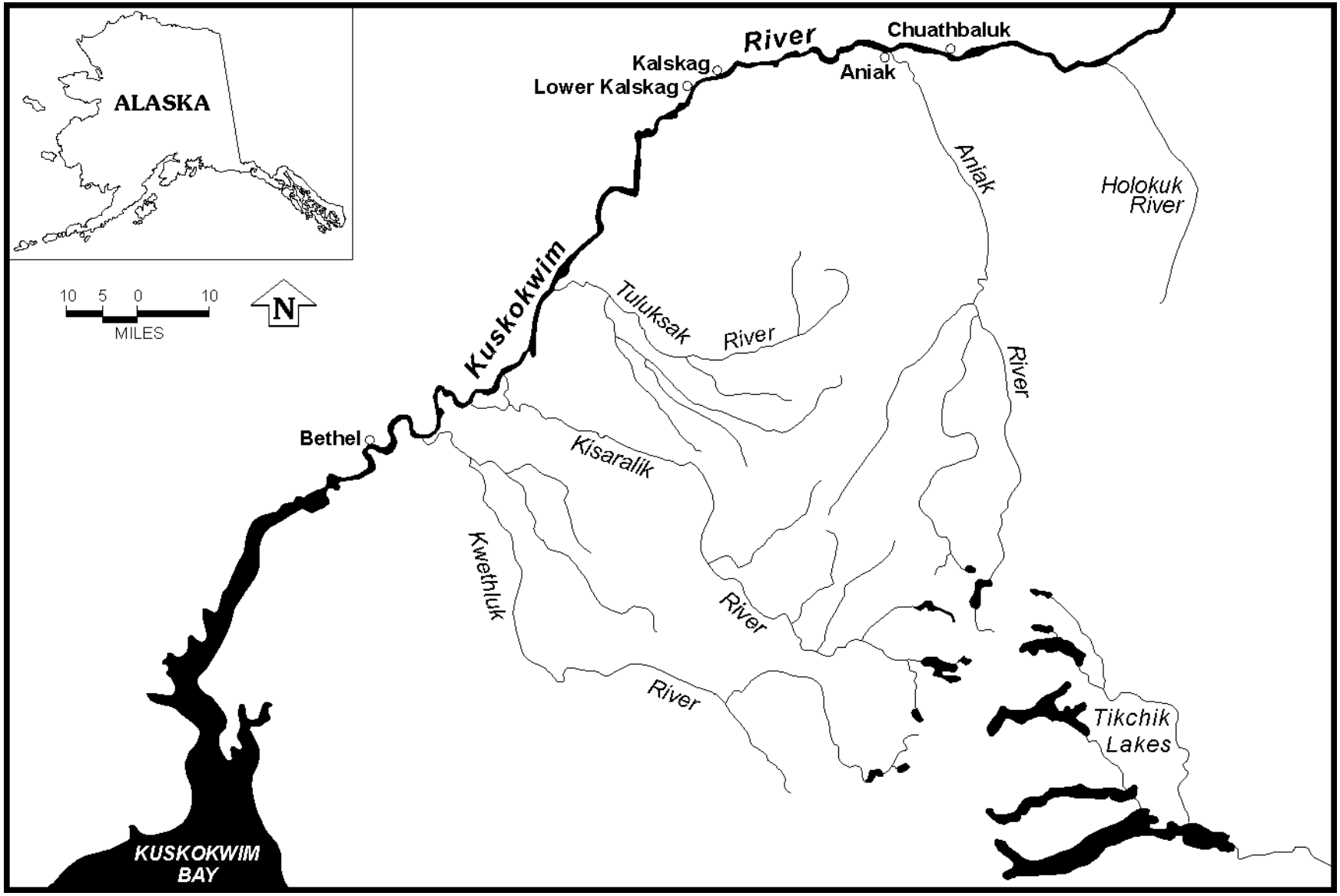

Figure 1.-The lower Kuskokwim tributaries, including the Aniak River.

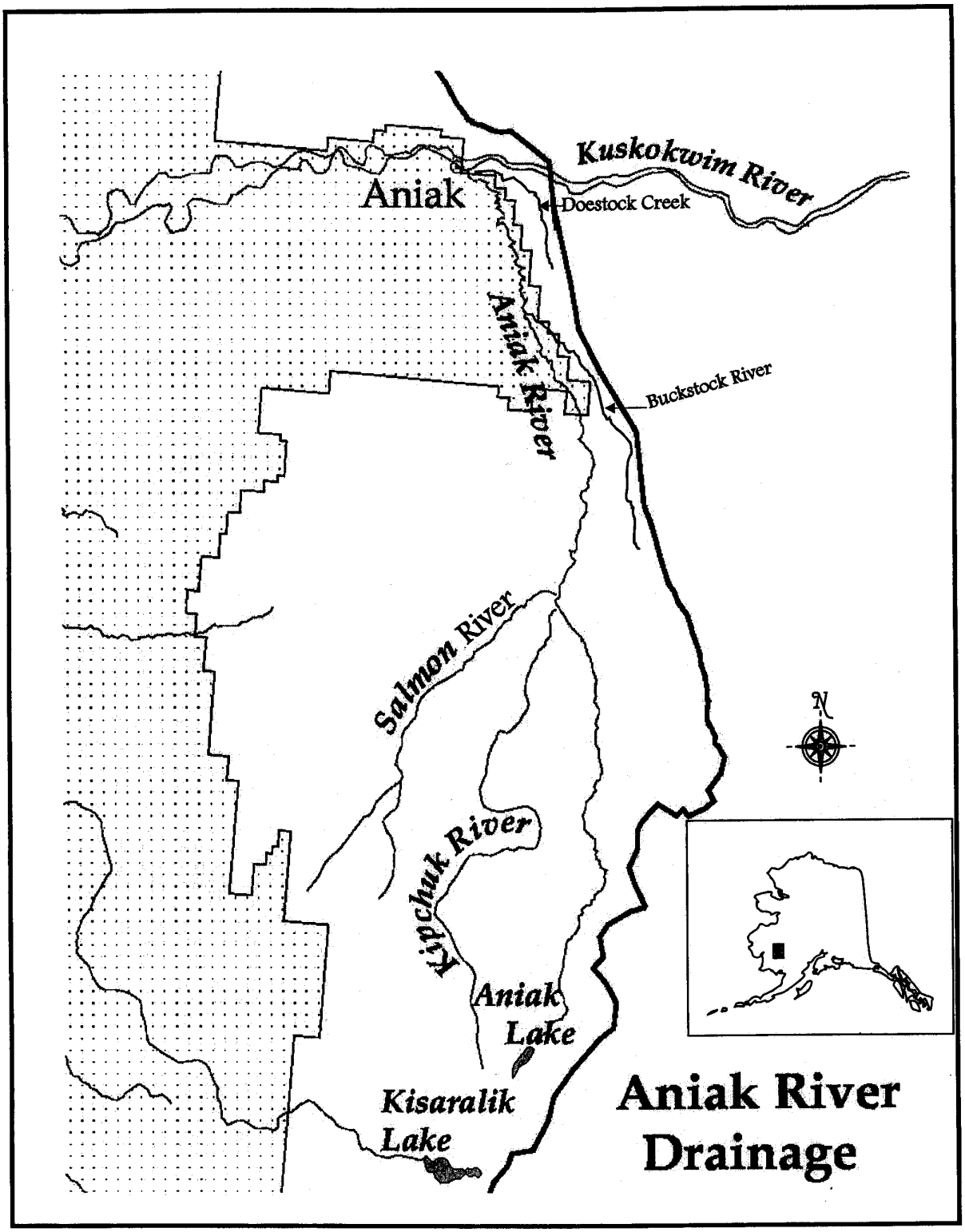

Figure 2.-Aniak River drainage.

In 1996, Division staff returned to the Aniak River for a more extensive survey of the sport fishery and to collect biological information from the middle and lower sections of the Aniak River. At this time the sport fishery did not appear to be a threat to the resident fish species. However, there was local support for additional restrictions on the sport harvest of resident fish species. The sport fishery did not appear to be in conflict with the subsistence fisheries. ADF&Gs annual mail survey of recreational anglers (the aforementioned SWHS) was expanded in the early 1990s resulting in estimates of fishery parameters, such as effort, catch, and harvest information of the sport fishery in the Aniak River. Although, the department has basic harvest information on the Aniak River sport fishery, our ability to obtain precise estimates of effort, catch and harvest is limited in a sport fishery of this small size. Households who reported fishing in the Aniak River in the mail survey during the last three years has averaged only 33 households. The department's confidence in estimates from the mail survey is dependent on the number of responses. Consequently, many managers consider fluctuating harvest estimates from the annual mail survey as indices of harvest magnitude (tens, hundreds, and thousands) from small sport fisheries. Over the last twelve years, the SWHS has reported angler effort in the range of 500 to 1,200 anglers participating annually (Table 1).

Sport anglers expended approximately 1,800 to 5,500 angler-days of effort on the Aniak River (Mills 1992-1994; Howe et al. 1995, 1996, 2001a-d; Walker et al. *In prep.*; Tables 1 and 2). Effort remained steady from 1995 through 1999, and peak angler effort in the Aniak River sport fishery occurred in 1998 with 5,548 angler-days. The harvest level for resident fish species in the past ten years has been in the hundreds, with annual harvests averaging less than 400 fish. Annual estimates of catch numbered in the thousands and a few estimates were in the tens of thousands.

During the last three years (1998-2000) estimates from the SWHS years indicated a decline in effort and subsequently declines in catch and harvest of both salmon and resident fish in the Aniak River. These declines are likely attributable to the rapid change in regulations of the Aniak River sport fisheries. Increasing growth in the sport fishery from 1996–1998 combined with poor returns of salmon during 1999 to the Aniak River prompted local concern for resident fish species in the Aniak River. The low confidence in the SWHS estimates and the dearth of stock specific information on Aniak River resident fish species is a concern to fishery managers and local people who rely on these resources for subsistence. Perceived low resident species production circumstantially related to poor chinook and chum salmon returns has increased concerns expressed by the residents of Aniak. The growth of the sport fishery from 1996–1998 heightened local concerns and local people believe that the resident fish population cannot withstand those sport angler harvest rates coupled with subsistence needs. Even though sport fishing effort declined in 1999 and 2000 local leaders describe a chronic decline in resident species and requested catch-and-release regulations be implemented to protect existing Arctic grayling, Dolly Varden, northern pike, lake trout, sheefish, and whitefish stocks in 2000. Additionally, a companion subsistence regulation was implemented to mirror the sport fishing regulations.

Table 1.-Number of anglers, effort (angler-days), harvest, and catch of salmon in the sport fishery of the Aniak River drainage, by year 1989-2000.

			Chinook		Coho		Chum		Sockeye		Pink	
Year	Anglers	Effort[a]	Harvest	Catch	Harvest	Catch	Harvest	Catch	Harvest	Catch	Harvest	Catch
1989	964	4,035	738	NA[b]	939	NA[b]	1,140	NA[b]	22	NA[b]	34	NA[b]
1990	493	1,964	285	1,181	182	571	159	1,301	49	182	29	217
1991	662	3,078	214	222	327	1,432	169	656	38	151	0	0
1992	673	2,604	172	827	235	575	304	1,670	25	74	156	998
1993	580	2,056	300	1,426	213	753	101	2,412	17	79	10	364
1994	634	1,815	437	573	507	852	231	1,342	17	87	0	388
1995	903	3,569	279	2,729	852	2,246	127	2,785	43	166	0	116
1996	1,058	3,078	641	4,531	957	4,639	298	4,691	142	279	0	301
1997	1,252	4,778	801	13,069	978	4,604	86	2,387	391	567	0	357
1998	1,049	5,548	1,058	5,896	1,128	3,639	101	2,664	178	367	40	168
1999	789	3,235	134	2,776	436	3,971	139	4,055	21	407	0	53
2000	553	2,141	10	431	440	8,531	0	3,914	23	286	0	144
Average	801	3,158	422	3,060	600	2,892	238	2,534	81	240	22	282
1998-2000 Average	797	3,641	401	3,034	668	5,380	80	3,544	74	353	13	122

[a] Effort is estimated as angler-days across all fish species from the Statewide Harvest Survey (Mills 1990-1994, Howe et al. 1995, 1996, 2001a-d, and Walker et al. *In prep*).

[b] Catch estimates available starting in 1990.

Table 2.-Historical effort (angler-days), harvest and catch of resident fish species in the sport fishery of the Aniak River drainage, 1989-2000.

			Rainbow Trout		Dolly Varden		Arctic Grayling		Northern Pike		Sheeefish	
Year	Anglers	Effort[a]	Harvest	Catch	Harvest	Catch	Harvest	Catch	Harvest	Catch	Harvest	Catch
1989	964	4,035	101	NA[b]	808	NA[b]	909	NA[b]	70	NA[b]	0	NA[b]
1990	493	1,964	35	2,216	598	6,174	422	5,259	18	53	0	0
1991	662	3,078	76	1,881	547	3,514	1,085	4,841	244	1,448	13	141
1992	673	2,604	32	934	115	3,736	121	3,855	43	794	0	11
1993	580	2,056	10	1,144	260	9,340	288	5,580	0	45	0	626
1994	634	1,815	8	656	496	3,115	116	2,022	54	698	88	154
1995	903	3,569	0	1,581	481	3,454	53	2,266	77	623	9	113
1996	1,058	3,078	21	3,457	195	6,096	398	5,095	443	959	26	119
1997	1,252	4,778	53	12,38	316	12,158	162	15,194	42	305	22	227
1998	1,049	5,548	349	5,004	394	21,053	715	11,930	553	1,883	30	47
1999	789	3,235	175	4,659	114	5,909	437	8,659	94	674	81	290
2000	553	2,141	24	4,643	40	5,333	42	5,950	0	298	0	7
Average	801	3,158	74	3,505	364	7,262	396	6,423	137	707	22	158
1998-2000 Average	797	3,641	183	4,769	183	10,765	398	8,846	216	952	37	115

[a] Effort is estimated as angler-days across all fish species from the Statewide Harvest Survey (Mills 1990-1994, Howe et al. 1995, 1996, 2001a-d, and Walker et al. *In Prep*).

[b] Catch estimates available starting in 1990.

To meet this concern, during the March 2000 Board of Fisheries (BOF) meeting, a management plan for the resident fish species in Aniak River was developed and implemented. This plan is a series of species specific regulations restricting bag and possession limits and implementing catch-and-release restrictions by time and area for Arctic grayling, Dolly Varden, northern pike, lake trout, sheefish, and whitefish. During the period of June 1 through August 31 all resident fish species caught above Doestock Creek must be released. The same types of catch-and-release regulations were implemented in the coho salmon sport fishery in the Aniak River, except the regulation applied to the area upstream of the Buckstock River. These temporary regulations had a sunset clause that required the BOF to revisit this subject during the normal scheduling cycle of the Arctic-Kuskokwim-Yukon (AYK) region in January 2001.

During the March 2000 BOF meeting, rod-and-reel was recognized as a method for subsistence fishing within the region of the Association of Village Council Presidents, Inc. (AVCP) (AAC 2001b). The BOF established the Aniak Subsistence Management Plan with regulations that were identical to the sport fishing regulations during the period of June 1 through August 31 (AAC 2001c). Subsistence users that reside upstream of Doestock Creek reacted negatively, resulting in a submission of a local petition (the Aniak subsistence proposal) for consideration by the BOF during their January 2001 meeting. A compromise that maintains parity between the sport and rod-and-reel subsistence fishing regulations for the Aniak River were achieved during this meeting. An aggregate daily bag limit of 3 salmon and 3 resident fish species was implemented. The subsistence rod-and-reel fishery has these limitations during the period of June 1 through August 31, whereas the sport fishery has the same limitations throughout the year along with some additional restrictions, including: of the 3 salmon per day only 2 can be chinook salmon greater than 20 inches in length; additionally an annual limit of 2 chinook salmon greater than 20 inches applies to the sport fishery. Restrictions for sockeye, pink, and coho salmon include daily bag limit is 3 fish with no size limit. Chum salmon must be released immediately in the Aniak River. The sport fishing regulations of 3 resident fish species is slightly different than the subsistence rod-and-reel regulations in the Aniak River. Anglers may retain up to three different species of resident fish, except rainbow trout, but only one of any given species of resident fish.

Public concerns regarding the health of the Aniak River fish stocks have remained an important issue. An evaluation of the rod-and-reel fishery of the Aniak River was supported by the community and area managers. The Kuskokwim Native Association (KNA) offered to work in a partnership with Division of Sport Fish to further understand the sport and subsistence fishery in the Aniak River. Local support from KNA, the community, and anglers was essential in collecting rod-and-reel survey information.

OBJECTIVES AND TASKS

The Aniak River rod-and-reel fishery characteristics (e.g., angler effort for, and catch and harvest by fish species) were estimated for two separate portions of the river: (1) the rod-and-reel fishery downstream from Buckstock River; and (2) the rod-and-reel fishery upstream of the Buckstock River. The majority of the anglers participating upstream of the Buckstock River floating down from one of two drop-off locations, whereas anglers access the Aniak fishery downstream of Buckstock River by a wider variety of methods. Additionally, the level of participation in the upper river reach was expected to be substantially less than in the lower reach. Furthermore, the upper river fishery is spread-out over a substantially larger geographic area. Accordingly, the

study design characteristics constrain the types and precision of fishery parameters that can be estimated for the two different river reaches.

OBJECTIVES

Specific objectives for the survey downstream of the Buckstock River during June 20 through August 31, 2001 were to estimate:

1. the catch and harvest of chinook, chum, and coho salmon by the rod-and-reel fishery such that estimates of catch are within 35% of the true catch, and estimates of harvest are within 50% of the true harvest 80% of the time;
2. the age, sex, and length composition of chinook, chum and coho salmon harvested by the rod-and-reel fishery such that the estimated percentages are within 15 percentage points of the true percentages 80% of the time;
3. The catch and harvest of resident fish species (rainbow trout, Dolly Varden, Arctic grayling, northern pike, sheefish, and burbot) by the rod-and-reel fishery such that the estimates of catch are within 35% of the true catch, and estimates of harvest are within 50% of the true harvest 80% of the time;
4. the length composition of resident fish species harvested by the rod-and-reel fishery such that the estimated percentage is within 15 percentage points of the true percentage 80% of the time;
5. the effort (angler-hours) downstream of the Buckstock River in the rod-and-reel fishery such that the total estimated angler effort is within 35% of the true effort 80% of the time; and,
6. the composition of angler-trips by terminal tackle type (flies, bait, or lures) and angler type (local, Alaska, and non-Alaska resident), services utilized (guided, unguided, or outfitter/air charter) of those anglers participating in the rod-and-reel fishery downstream of the Buckstock River, such that the estimated percentages are within 15 percentage points 80% of the time.

The specific objective for the survey upstream of the Buckstock River for salmon and resident fish species in the rod-and-reel fishery during June 20 through August 31, 2001 was to characterize the:

7. the catch and harvest rate (catch or harvest per angler-trip) for salmon (chinook, chum, and coho salmon) and resident fish species (rainbow trout, Dolly Varden, Arctic grayling, northern pike, sheefish, and burbot) by the portion of the rod-and-reel fishery who voluntarily report their fishing-trip characteristics.

TASK

In addition to the objectives outlined above the task to conduct a <u>weekly</u> count of anglers participating in this portion of the fishery by aerial survey methods was addressed for the Aniak River rod-and-reel fishery upstream of the Buckstock River.

An evaluation of the feasibility of combining the information collected from these counts with the results from Objective 7 was conducted with the goal of attempting to obtain estimates of total catch and harvest by fish species in this section of the river.

STUDY DESIGN

DOWNSTREAM OF THE BUCKSTOCK RIVER

A modified stratified two-stage roving-roving creel survey (Bernard et al. 1998) was used to estimate the number of angler-hours fished by participants in the rod-and-reel fishery in the lower (downstream of the Buckstock River) Aniak River, as well as catch and harvest by fish species (Objectives 1, 3, and 5). The first-stage sampling units were days. Daily catch and harvest were to be estimated as the product of effort and catch-per-unit-effort (CPUE) and harvest-per-unit-effort (HPUE), respectively. Second-stage sampling units for estimating effort (angler-hours) were periodic counts of anglers conducted from a boat roving through the fishery. Second-stage sampling units for estimating CPUE and HPUE were angler-trips, sampled by interviewing anglers who had completed fishing for the day and had exited the fishery, as well as obtaining completed-trip information from anglers who had not completed their fishing trip by the use of voluntary daily fishing logs (handed to anglers during the interview process). The entire fishing day was sampled to minimize problems with length-of-stay bias (Bernard et al. 1998). Harvest refers to fish hooked and retained by anglers as part of their creel. Catch refers to fish hooked and retained plus those reported to be released by anglers, but not those that broke off before the fish was released by the angler.

During the interview process anglers were asked questions to characterize their demographic attributes and terminal angling gear usage to obtain the estimates associated with Objective 6. Additionally, the fish were sampled to collect information to estimate the age, sex, and length composition of harvested salmon (Objective 2) as well as the length composition of harvested resident fish species (Objective 4).

The period of June 20 through August 31 was selected for sampling to insure that the survey covers the majority of the salmon and resident fish rod-and-reel fishery occurring during the summer in the Aniak River. The lower thirty river miles of the Aniak River, downstream of the Buckstock River is the area where most of the rod-and-reel effort is focused. This 30-mile section was too large to survey with only one survey crew, therefore the lower 30 miles was split into two sections, the Buckstock River to Doestock Creek and Doestock Creek to the mouth, approximately 15 river miles for each section. These two sections were treated as separate sampling strata.

Days to sample were selected by a compromised systematic selection process consisting of approximate every-other day sampled (with two contiguous days off scheduled every week to comply with work rules). The stratum to sample on the first day of the survey was selected at random. Following this selection the non-selected stratum was then selected for sampling the following day. This alternating sample allocation continued until the first set of regularly scheduled days off (RDO). The selection process for days to sample within each stratum does <u>not</u> guarantee that every day has equal probability of selection. However, through the course of the survey from June 20 to August 31 the allocation of samples to day of the week was approximately even (Table 3).

Table 3.-Summary of the number of days sampled for the lower Aniak River strata by day of week during the period from June 20 to August 31, 2001.

	Number of Days Selected for Sampling out of the Total Number of Days within each Stratum (percentage)	
Day of the Week	Aniak River from the Buckstock River to Doestock Creek	Aniak River from Doestock Creek to the Kuskokwim River Confluence
Monday	4 out of 10 (40.0%)	4 out of 10 (40.0%)
Tuesday	3 out of 10 (30.0%)	4 out of 10 (40.0%)
Wednesday	4 out of 11 (36.4%)	3 out of 11 (27.3%)
Thursday	3 out of 11 (27.3%)	3 out of 11 (27.3%)
Friday	4 out of 11 (36.4%)	3 out of 11 (27.3%)
Saturday	4 out of 11 (36.4%)	4 out of 11 (36.4%)
Sunday	4 out of 10 (40.0%)	4 out of 10 (40.0%)
Total	26 out of 74 (35.1%)	25 out of 74 (33.8%)

It was not expected that the intensity of the fishery varies substantially according to the days of the week. This expectation when combined with the nearly equal sample allocation among days of the week (Table 3) indicated that point estimates derived from the survey (catch, effort, and harvest) should not be biased because of the sample allocation procedure used. Estimates of sampling variances however will only be approximately unbiased since the sample allocation was a compromised systematic sample.

On each day selected for sampling the survey crew conducted a series of three counts of anglers and conducted interviews within the one of the two lower 15 mile sections of the Aniak River. Between the morning and afternoon angler count the survey crew interviewed participants in the rod-and-reel fishery. Most anglers contacted were not expected to have completed fishing at the time of the interview. Completed fishing-trip information was collected from the anglers who were interviewed at the end of their fishing trip. All other interviewed anglers were handed a daily fishing log to be completed by the angler in order to obtain completed-trip information from as many interviewed anglers as possible. Anglers were informed that the daily fishing logs could be returned to KNA or field technicians. Additionally, fishing guides and lodge operators were asked to cooperate by recording the catch and harvest information of their clients. Survey clerks visited lodges and guide camps seeking completed daily fishing logs.

The sampling day was defined as the 15 hour period from 0800 hours to 2300 hours, and was assumed to cover the period of the day in which the majority of rod-and-reel fishing activity occurs. The sampling day was partitioned into 5 count and interview blocks. Three roving angler counts were conducted from a boat. Each count required about one-hour to conduct while traversing the 15 river miles for each lower river strata. Two interview sampling periods were scheduled to occur between the three counts for a total of two hours during each period. Accordingly, each sampling day consisted of about four hours of interviews and three angler counts of one-hour spread throughout the sampling day.

Angler count-time combinations were selected at random for each sampled day within each of the lower river stratum from the five possible systematic count combinations (Table 4). During each block, a crew of two technicians conducted angler counts, angler interviews, and collected biological data from harvested fish they encountered in each sample strata (Objectives 1-6). The

field camp located upstream of the Doestock Creek is the approximate mid-point location of the lower 30 miles of the Aniak River. Additionally, the survey crew in the lower Aniak contacted and interviewed anglers along the beach at the confluence of the Aniak and Kuskokwim rivers. As time allowed, the survey technicians contacted anglers leaving the fishery at the Aniak airport to collect daily fishing logs.

Table 4.-Survey count and interview hours for the lower Aniak River rod-and-reel survey for five systematic count combinations of three counts per sample day during the period from June 20 to August 31, 2001.

Sample Block	Angler Count	Interview Period	Angler Count	Interview Period	Angler Count
A	0800-0900	1000-1200	1301-1400	1400-1600	1801-1900
B	0900-1000	1100-1300	1401-1500	1500-1700	1901-2001
C	1000-1100	1200-1400	1501-1600	1600-1800	2001-2100
D	1100-1200	1300-1500	1601-1700	1700-1900	2101-2200
E	1200-1300	1400-1600	1701-1800	1800-2000	2201-2300

During the interview process, survey technicians measured fish lengths and recorded this information on standard AWL mark-sense forms (Objectives 2 and 4) and collected age structures such as scales or otoliths for aging purposes. Additionally, anglers were asked questions regarding their demographic characteristics and terminal angling gear usage (Objective 6).

UPSTREAM OF THE BUCKSTOCK RIVER

A voluntary reporting system was used to collect information from anglers participating in the Aniak River rod-and-reel fishery upstream of Buckstock River to estimate catch and harvest rates (Objective 7). Efforts were made to insure that all anglers participating had an equal probability of receiving a weekly fishing log prior to their fishing-trip in this portion of the Aniak River rod-and-reel fishery. Anglers who failed to respond (both those who failed to receive a log form, refused to fill a log form, forget to return the log, etc.) were not assumed to be similar in their characteristics to anglers who do respond. Accordingly, the estimates obtained from this portion of the survey may not be unbiased, but are assumed to provide information that may be useful in making fishery management decisions.

The majority of the anglers participating upstream of the Buckstock River were expected to be floating down from one of two drop-off locations on the Kipchuk or Salmon Rivers (Figure 2). Local air charter operators supplied anglers with a weekly fishing log form to assist them in recording their daily catch of salmon and resident fish species. The survey clerks targeted collecting completed-trip angler information during interviews (conducted during the lower river survey, see above) and collecting weekly fishing logs. For those anglers that were missed during interviewing, the Department and KNA return address was provided on the fishing log forms. Survey clerks were expected to carefully communicate to the anglers, lodge operators, guides, and air taxi operators regarding the importance of returning the cards. The survey clerks were encouraged to use every means to recover completed cards while respecting each angler's right to refuse to participate.

Anglers were counted from a fixed wing aircraft once a week upstream of the Buckstock River. These weekly counts provided a rough estimate of the level of participation in angler-trips (Task 1). Angler use patterns of the area suggested that angler count surveys flown on Monday, Tuesday, or Wednesday would be representative of anglers fishing in this reach of the Aniak River, which are predominately float-trip anglers. The rotation of float trips in upper section tends to follow a weekend start and late weekday finish at or downstream of the Buckstock River. Therefore a weekly systematic approach was expected to capture angler effort across the survey period in the float area of the Aniak River.

An evaluation of the feasibility of combining information from the weekly angler count with the catch and harvest rate information collected via the voluntary weekly fishing logs was to have been conducted to possibly obtain estimates of catch and harvest by fish species. Additionally the count information was to be used to gauge the success of the weekly fishing log data collection effort. For example, if substantially more anglers were counted fishing in the upper river than those anglers who turn in weekly fishing logs then the data collection effort would be judged a failure. Conversely, if the number of weekly fishing logs collected compare favorably to the number of anglers counted then the evidence would indicate that the data collection effort for catch and harvest rate effort was successful.

DATA COLLECTION

ANGLER INTERVIEWS

During each selected sampling day, the survey technicians traveled throughout the fishery to conduct interviews and counts of all people participating in the rod-and-reel fishery according to the randomly selected sampling blocks. Interviews consisted of obtaining catch, harvest, angler type (guided, unguided, guides), terminal tackle, and general demographic information from anglers encountered in the fishery. All anglers including those who have not completed fishing for the day (incompleted-trip interviews) were interviewed. All data was recorded on Divisional standard mark-sense forms and summarized into computer files and archived with Division of Sport Fish (Appendix C1).

Many of the interviews are expected to be of anglers who have not completed fishing for the day. Accordingly, the success of this survey is dependent upon the number of properly completed voluntary report cards returned. Therefore the survey clerks were expected to carefully explain to each angler and to remind lodge operators, guides, and air taxi operators as to the importance of the cards to maximize the number of returns. On a weekly basis completed fishing logs were entered on standard Angler Interview mark-sense forms, that were labeled with a different sub-location code to ensure that this information could be extracted from the database during final data analysis.

ANGLER COUNTS

Upstream of the Buckstock River, a fixed wing aircraft was chartered once a week to count anglers fishing. As noted previously, angler use patterns of the area indicated that angler count surveys flown on Monday, Tuesday, or Wednesday would be representative of anglers fishing in this area of the Aniak River, which are predominately float-trip anglers. The rotation of float trips in the upper section tends to follow a weekend start and late weekday finish at or downstream of the Buckstock River.

In the lower Aniak River, below Buckstock River, each survey had three angler counts within the 15 hour (0800 to 2300 hours) sampling day. Once at the starting point, either boundary of the sampling strata, the creel technician counted all active anglers[1] while driving the boat in a slow manner (i.e., no boat wake) at a reasonable distance away from other boats through the fishery to the far boundary of the study section. Counts were expected to take a maximum of 60 minutes from beginning to end and commenced according to the sampling schedule.

As with angler interviews the count data was recorded on standard Divisional mark-sense forms and summarized into computer files and archived with Division of Sport Fish (Appendix C1).

BIOLOGICAL COMPOSITION

Harvested salmon and resident fish species encountered during the angler interview portion of the rod-and-reel surveys were measured for length. Salmon were measured from mid eye to the fork of the tail. Resident fish species were measured for total length, tip of the snout to end of the tail. All length measurements were recorded to the nearest five (5) millimeters. Salmon were sexed based on external characteristics. All information was recorded on Division of Sport Fish age-length mark sense forms.

Age structures, scales, and otoliths were collected opportunistically from the observed harvest with permission from the angler. Standard procedures were followed for field collection of age samples. Three (3) scales from the preferred area were mounted on an adhesive-coated card for salmon, grayling, and sheefish. Adhesive-coated cards with scale samples were pressed against acetate cards in heated hydraulic press and resulting scale impressions were displayed on the microfiche projector for age determination. Procedures for age determination followed the methods of Welander (1940), Lux (1971), and Jearld (1983). Otoliths were collected from Dolly Varden and northern pike and placed in coin envelopes for storage. Ages determined from otoliths following the surface reading procedures of Chilton and Beamish (1982).

DATA ANALYSIS

DOWNSTREAM OF THE BUCKSTOCK RIVER

Angler Effort, Catch and Harvest Estimates

Angler effort, catch, harvest, and associated variances and standard errors were estimated for the creel survey using modifications of the procedures outlined by Bernard et al. (1998). The modifications to the standard procedures were necessitated by the paucity of interviews obtained (Appendix A1), which resulted from lower levels of participation relative to that which was expected pre-season (Table 5). The lower level of participation was assumed to be due to the

[1] People who were handling or using fishing rods and tackle; including people who may have interrupted their fishing to reposition their boat, land a fish, repair their gear (tie on a new lure, fix a tangle, etc.) or assist another person with their fishing activities. An active angler did not include a guide or boat operator.

Table 5.-Angler counts of rod-and-reel sport and subsistence anglers in the lower Aniak River, downstream of the Buckstock River to the confluence of the Kuskokwim River, 22 June through 28 August, 2001.

	Buckstock River to Doestock Creek			Doestock Creek to Kuskokwim River Confluence			
Day & Date	Morning Count	Afternoon Count	Evening Count	Morning Count	Afternoon Count	Evening Count	Average Count
F June 22	0	0	0				0.0
S June 23				0	0	0	0.0
S June 24	1	0	3				1.3
M June 25				0	2	0	0.7
T June 26	No survey						
W June 27	Day Off						
Th June 28	Day Off						
F June 29				0	0	0	0.0
S June 30	0	0	0				0.0
S July 1				2	Motor trouble	3	2.5
M July 2	0	3	1				1.3
T July 3	No survey						
W July 4	4	2	0				1.7
Th July 5				1	0	0	0.3
F July 6	Day Off						
S July 7	Day Off						
S July 8	5	3	6				4.7
M July 9				3	3	0	2.0
T July 10	6	4	5				5.0
W July 11				5	0	0	1.7
Th July 12	4	3	5				4.0
F July 13				5	4	6	5.0
S July 14	Day Off						
S July 15				9	0	0	3.0
M July 16	0	3	2				2.5
T July 17				1	2	1	1.3
W July 18	Day Off						
Th July 19	Day Off						
F July 20	28	6	0				11.3
S July 21				0	0	0	0.0
S July 22	21	18	18				19.0
M July 23	Day Off						
T July 24	Day Off						

-continued-

Table 5.-(Page 2 of 2).

Day & Date	Buckstock River to Doestock Creek			Doestock Creek to Kuskokwim River Confluence			Average Count
	Morning Count	Afternoon Count	Evening Count	Morning Count	Afternoon Count	Evening Count	
W July 25				1	2	0	1.0
Th July 26	0	8	0				2.7
F July 27				2	5	0	2.3
S July 28	10	3	4				5.7
S July 29				6	0	0	2.0
M July 30	Day Off						
T July 31	Day Off						
W Aug 1	15	11	4				10.0
Th Aug 2				4	4	13	7.0
F Aug 3	4	5	3				4.0
S Aug 4				0	11	6	5.7
S Aug 5	6	13	0				6.3
M Aug 6				3	4	3	3.3
T Aug 7	Day Off						
W Aug 8	Day Off						
Th Aug 9	5	2	4				3.7
F Aug 10				9	16	6	10.3
S Aug 11	15	17	4				12.0
S Aug 12				9	14	8	10.3
M Aug 13	7	0	0				2.3
T Aug 14				3	16	12	10.3
W Aug 15	Day Off						
Th Aug 16	Day Off						
F Aug 17	3	3	0				2.0
S Aug 18				4	15	3	7.3
S Aug 19	9	0	0				3.0
M Aug 20				0	5	0	1.7
T Aug 21	3	3	0				2.0
W Aug 22				0	0	3	1.0
Th Aug 23	Day Off						
F Aug 24	Day Off						
S Aug 25	11	3	0				4.7
S Aug 26				0	0	0	0.0
M Aug 27	3	3	0				2.0
T Aug 28				0	0	0	0.0

inseason fishing restrictions put in place by a Special Action issued by the Federal Subsistence Board.

This "sparse data" problem (i.e., too few interviews) was addressed by grouping adjacent days of samples together and treating each group of days as a de facto sampling stratum. Since catch and harvest rates were expected to vary over the course of the summer (especially for the salmon species as abundance fluctuated with the waxing and waning of the run) the number of days to group together were kept to a minimum so the potential biases that might otherwise be introduced was kept to a minimum[2].

Additionally, the relatively low number of interviews of all anglers also necessitated that all interview types (completed and incompleted-trip) had to be used in the estimation procedures. The possible bias due to using incompleted-trip interviews to measure catch and harvest rates was assumed to be low since the majority of participants in this relatively remote fishery were assumed to not vary their fishing trips due to success rate (e.g., quit fishing after filling their bag limit on one species).

Angler effort estimates in angler-hours for each group of combined days were calculated by treating the angler count data from each sampled day within the group as a systematic sample. The corresponding estimation equations were those appropriate to a two-stage sampling design within each combined group of days (i.e., with days as the first-stage sampling units and counts within a day as the second stage sampling units). The angler effort estimates and their variances were calculated as follows, by first estimating the angler effort within each sampled day (adapted from Bernard et al. 1998):

$$\hat{E}_{hij} = T\ \bar{x}_{hij} \tag{1}$$

where:

$\hat{E}_{hij}$ = estimated angler effort in angler-hours for day j, within combined-group of days i, and stratum h (above and below Doestock Creek);

T = the sampling day length, in this case = 15 hours;

$\bar{x}_{hij}$ = the mean number of anglers within each day sampled, calculated as:

$$\bar{x}_{hij} = \frac{\sum_{k=1}^{r_{hij}} x_{hijk}}{r_{hij}}; \tag{2}$$

x_{hijk} = number of anglers during count k; and,

[2] Bias might be introduced in estimates of catch or harvest if, say for example, days in which the catch or harvest rate were relatively high and interviews were obtained were combined with days with relatively low catch or harvest rate and a relatively large amount of angler effort was expended on the low catch/harvest rate day. The bias for any particular grouping of days was not necessarily in one direction or another (too high or too low). By restricting the days to group to the minimal number necessary to adequately estimate the catch rate, and by grouping only adjacent days it was expected that the degree of bias introduced was minimized.

Conversely, ignoring the sparse data problem would have introduced a large degree of bias, as some days with relatively large levels of angler effort at times had only a few corresponding angler interviews that may have not been representative of all anglers fishing on that day.

r_{hij} = the number of angler counts conducted within each day, usually equal to 3 (but on some days the number of counts was less than the planned number, mostly due to equipment problems).

The next step involved calculating an average angler effort in angler-hours across days within each combined-group of days:

$$\overline{\hat{E}}_{hi} = \frac{\sum_{j=1}^{d_{hi}} \hat{E}_{hij}}{d_{hi}} \tag{3}$$

where:

d_{hi} = the number of days sampled within each combined-group of days.

Estimates of angler effort within each combined-group of days was then calculated by expanding this average by the number of days within the group:

$$\hat{E}_{hi} = D_{hi}\ \overline{\hat{E}}_{hi} \tag{4}$$

where:

D_{hi} = the number of days within each combined-group of days.

The variance of this estimate was calculated by the standard two-stage equation (see Thompson 1992):

$$\hat{V}\left(\hat{E}_{hi}\right) = \left(1 - f_{1hi}\right) D_{hi}^2 \frac{S_{1hi}^2}{d_{hi}} + f_{1hi} D_{hi}^2 \frac{\sum_{j=1}^{d_{hi}} \hat{V}\left(\hat{E}_{hij}\right)}{d_{hi}^2} \tag{5}$$

where:

f_{1hi} = the sampling fraction within each combined-group of days, equal to:

$$f_{1hi} = \frac{d_{hi}}{D_{hi}}; \tag{6}$$

S_{1hi}^2 = the between-day variance of the estimated angler effort among the sampled days within each combined-group of days, calculated using the successive difference formula appropriate for systematic sampling recommended by Wolter (1985), since days sampled were systematically selected within each river-reach stratum:

$$S_{1hi}^2 = \frac{\sum_{j=2}^{d_{hi}} \left(\hat{E}_{hij} - \hat{E}_{hi(j-1)}\right)^2}{2\left(d_{hi} - 1\right)}; \text{ and} \tag{7}$$

$\hat{V}\left(\hat{E}_{hij}\right) =$ the variance of the estimated angler effort for each sampled day, calculated as the product of the square of the hours in the sampling day and the variance of the mean count within the day (using the successive difference formula appropriate for systematic sampling as above, since times to conduct counts within the day were systematically selected):

$$\hat{V}\left(\hat{E}_{hij}\right) = T^2 \hat{V}\left(\bar{x}_{hij}\right) = T^2 \frac{\sum_{k=2}^{r_{hij}} \left(x_{hijk} - x_{hij(k-1)}\right)^2}{2\, r_{hij}\left(r_{hij} - 1\right)} . \tag{8}$$

Estimates of catch and harvest were obtained by a ratio estimator: by combining the estimated effort with estimates of the average catch per unit effort (CPUE) and harvest per unit effort (HPUE) obtained from the angler interviews and/or the daily fishing logs, within each combined-group of days for each stratum. The following equations were adapted from Bernard et al. (1998). The first step involves calculating the average CPUE over all anglers interviewed within the combined-group of days (i.e., ignoring the day of the interview):

$$\overline{CPUE}_{hi} = \frac{\sum_{j=1}^{d_{hi}} \sum_{o=1}^{m_{hij}} C_{hijo}}{\sum_{j=1}^{d_{hi}} \sum_{o=1}^{m_{hij}} e_{hijo}} \tag{9}$$

where:

$C_{hijo} =$ the catch (by species of fish) of interviewed angler *o*, within sampled day *j*, for combined-group of days *i*, for stratum *h*; and,

$e_{hijo} =$ hours fished by each interviewed angler.

Then catch is estimated by combining the angler effort estimate and the CPUE estimate as:

$$\hat{C}_{hi} = \hat{E}_{hi}\, \overline{CPUE}_{hi} . \tag{10}$$

The variance of this catch estimate was calculated using the following equation (Goodman 1960):

$$\hat{V}\left(\hat{C}_{hi}\right) = \hat{E}_{hi}^2\, \hat{V}\left(\overline{CPUE}_{hi}\right) + \overline{CPUE}_{hi}^2\, \hat{V}\left(\hat{E}_{hi}\right) - \hat{V}\left(\hat{E}_{hi}\right)\hat{V}\left(\overline{CPUE}_{hi}\right) \tag{11}$$

where:

$\hat{V}\left(\overline{CPUE}_{hi}\right) =$ the variance of the mean CPUE estimated as (Thompson 1992):

$$\hat{V}\left(\overline{CPUE}_{hi}\right) = \frac{\sum_{o=1}^{m_{hi.}} \left(C_{hijo} - e_{hijo}\, \overline{CPUE}_{hi}\right)^2}{\bar{e}_{hi}^2\, m_{hi.}\left(m_{hi.} - 1\right)} ; \tag{12}$$

$m_{hi.} =$ the total number of anglers interviewed across all days within the combined-group of days, summing over each day:

$$m_{hi.} = \sum_{j=1}^{d_{hi}} m_{hij} \text{ ; and,} \tag{13}$$

$\bar{e}_{hi}$ = the mean hours fished over all anglers interviewed within the combined-group of days, calculated as:

$$\bar{e}_{hi} = \frac{\sum_{j=1}^{d_{hi}} \sum_{o=1}^{m_{hij}} e_{hijo}}{m_{hi.}} . \tag{14}$$

Estimates of harvest were obtained similarly by substitution of the harvest statistics into the estimation equations above.

The preseason objectives for this survey identified that estimates of angler effort would be measured in terms of angler-hours (and the procedures as outlined above were appropriate for the angler-hour estimates). Alternative estimates of angler effort in angler-days were also calculated by combining the effort estimates in angler-hours with information from the average angler-hours expended by completed-trip anglers during their day of fishing (adapted from Bernard et al. 1998), as:

$$\hat{M}_{hi} \approx \frac{\hat{E}_{hi}}{\bar{e}'_{hi}} \tag{15}$$

where:

$\hat{M}_{hi}$ = the estimated number of angler-trips within the combined-day group of days within each river reach stratum, assumed to be approximately equal to the number of angler-days as most if not all completed-trip anglers are assumed to conduct only one fishing trip per day[3];

$\hat{E}_{hi}$ = the estimated angler-hours expended fishing by all anglers within each river reach stratum, as calculated by equation (4), above; and;

$\bar{e}'_{hi}$ = the mean hours fished over all completed-trip anglers interviewed within the combined-day group of days for each river reach stratum, as calculated by equation (14), above with the appropriate substitution (i.e., only completed-trip angler interviews).

The variance of this estimate was approximated by the equation in Bernard et al. 1998:

$$\hat{V}\left(\hat{M}_{hi}\right) \cong \hat{M}_{hi}^{2}\left[\frac{\hat{V}\left(\bar{e}'_{hi}\right)}{\bar{e}'^{2}_{hi}} + \frac{\hat{V}\left(\hat{E}_{hi}\right)}{\hat{E}^{2}_{hi}} - \frac{\hat{V}\left(\bar{e}'_{hi}\right)\hat{V}\left(\hat{E}_{hi}\right)}{\bar{e}'^{2}_{hi}\ \hat{E}^{2}_{hi}}\right] \tag{16}$$

where:

$\hat{V}\left(\hat{E}_{hi}\right)$= the variance of the estimated angler-hours expended fishing by all anglers within each river reach stratum, as estimated by equation (5), above and

[3] The estimate of angler-trips (or angler-days) was considered approximate not only due to the assumption regarding the equivalence of days versus trips, but also due to the assumption that the average trip length in angler-hours from completed-trip anglers was representative of the completed-trip length for all anglers (i.e., including completed-trip as well as incompleted-trip interviews).

$\hat{V}\left(\bar{e}'_{hi}\right) =$ the variance of the mean hours fished over all completed-trip anglers interviewed within the combined-day group of days for each river reach stratum, as calculated:

$$\hat{V}\left(\bar{e}'_{hi}\right) = \frac{\sum_{o=1}^{m'_{hi}} \left(e_{hi} - \bar{e}'_{hi}\right)^2}{m'_{hi}\left(m'_{hi} - 1\right)} \text{; and,} \tag{17}$$

$m'_{hi} =$ the total number of completed-trip anglers interviewed within each combined-day group of days for each river reach stratum.

Estimates of catch, harvest, and angler effort (and their variances) across the combined-day groups within the two river-reach strata were obtained by summing over the groups (i.e., treating the combined-day groups as independent strata). Similarly, total estimates (across river-reach strata) were obtained by summation.

Composition Estimates

The age, sex, and length compositions of harvested fish and the composition of angler-trips by demographic categories and terminal angling gear usage were to be estimated as simple proportions (ignoring stratification and sampling stages). Composition estimates and their variances were calculated as (Cochran 1977)[4]:

$$\hat{p}_k = \frac{n_k}{n} \text{ and} \tag{18}$$

$$\hat{V}\left[\hat{p}_k\right] = \frac{\hat{p}_k\left(1 - \hat{p}_k\right)}{\left(n - 1\right)} \tag{19}$$

where: $\hat{p}_k$ is the estimated proportion of harvest fish with characteristic *k* (i.e., age, sex, or length categories), or estimated angler-trips with characteristic *k* (e.g., local, non-local, etc.), n_k is the number of fish (or angler-trips) observed in the survey with characteristic *k*, and n is the number of fish (or angler-trips) sampled (constrained to equal the sample size of individuals that can be categorized).

Mean length-at-age as well as mean weight of harvested coho salmon were estimated, following standard procedures (Sokal and Rohlf 1981; Boxes 4.2 and 7.1, pages 56 and 139).

Assumptions

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

1. the angler count process was approximately instantaneous, or the survey technician traveled substantially faster than anglers move about or exit or enter the fishery;

[4] The angler-trip composition "estimates" reported later in this report were not assumed to be unbiased estimates of the composition of all rod-and-reel anglers participating in the fisheries, due to the relatively unbalanced number of anglers interviewed obtained. In other words the proportion of participating anglers interviewed during each sampled day fluctuated substantially so any composition estimates could only be assumed to be representative of the interviewed portion of the population of anglers. Accordingly, no estimates of variance were calculated since the composition values reported represent a census of the interviewed anglers.

2. interviewed anglers accurately reported their hours of fishing effort and the number of fish by species released;
3. interviewed anglers accurately reported where they caught fish and where their fishing was conducted (i.e., above or below Doestock Creek);
4. the creel technician accurately classified anglers and the interviewed anglers accurately reported their type (guided, unguided, guides), and the terminal gear type (baited versus unbaited) used during their fishing trip;
5. catch and harvest rate and duration of fishing trip were independent (DiCostanzo 1956) (necessitated by the use of a roving method of interviewing - anglers with longer fishing trips have a greater probability of being intercepted for interview);
6. the angler report card response rate did not vary among angler groups, that is all anglers regardless of their catch or harvest rate returned cards at the same average rate; and,
7. anglers who return report cards accurately reported their effort, catch, and harvest of chinook salmon by stratum (above and below Doestock Creek).

All of the variance estimates associated with catch and harvest were considered approximate since the modifications made to the standard estimating equations (as presented in Bernard et al. 1998) do not completely account for some of the components of sampling variability (i.e., two-stage samples for CPUE and HPUE treated as single-stage samples).

UPSTREAM OF THE BUCKSTOCK RIVER

Inadequate returns of the weekly fishing logs were obtained from rod-and-reel anglers fishing in the upper Aniak River which prevented the preseason plan to estimate of catch and harvest rates for rod-and-reel anglers participating in the portion of the fishery in the upper river. Accordingly, catch and harvest rates are not reported in this report.

The weekly angler counts conducted by flying over the fishery once each week may represent an unbiased measure of the number of anglers fishing each week. However the determination of how representative the counts were of angler effort in the upper section of the river depended upon collecting an adequate number of completed-trip interviews of anglers participating in this portion of the fishery.[5] Accordingly, the counts and characteristics of the counts (type of boat) were merely reported for informational purposes in this report.

RESULTS

SUMMARY OF COUNTS AND INTERVIEWS

Angler Counts

During the period from 22 June to 28 August, 2001 the survey field staff conducted a total of 146 separate counts in the Aniak River downstream of the Buckstock River (Table 5). Rarely did the count of anglers exceed ten (10) anglers. In only 17 instances were more than 10 anglers fishing in either section. The highest count of anglers was 28 during the morning count of Friday,

[5] The evaluation of the characteristics of the fishery was to have been conducted by comparing the information obtained from the weekly fishing logs with the weekly angler counts. If most anglers fishing in this section of the river took multi-day trips and nearly all of the trips began and ended such that most anglers were and could be counted during the weekly count, then each weekly count would have represented an estimate of the number of fishing-trips for each week. Accordingly, the lack of weekly fishing log returns prevented this evaluation.

July 20. Effort varied somewhat within the day. Between Buckstock River and Doestock Creek most anglers were participating during the morning period, whereas downstream from Doestock Creek most anglers were observed during the afternoon count periods.

Only 135 anglers were counted fishing in the rod-and-reel fishery upstream of the Buckstock River during weekly aerial surveys conducted from 27 June through 24 August (Table 6). Two of the weekly sampling events were canceled because of poor flying conditions: one in July and one in August. Forty-two boats and one aircraft on the water were observed during seven aerial surveys. Thirty-eight of the boats were rafts (90%), two boats were powered by prop outboards, and two boats were powered by jet units. Fifty percent of the rafts were observed during the last two surveys during mid to late August. The majority of the effort was observed in the Aniak River mainstem and Salmon River, and only a few participants floated from Aniak Lake, most likely due to difficult and possibly unsafe floating conditions because of the large amounts of log jams and debris.

Survey Interviews

There were a total of 114 interviews of participants who fished downstream of the Buckstock River, and of these 97 were of completed-trip anglers and 17 of the interviews were from incompleted-trip anglers. Thirteen of the seventeen incompleted-trip interviews occurred in the river section downstream of Doestock Creek. Completed-trip interviews were somewhat more evenly split between the sampling sections (54 above and 43 below the Doestock Creek).

As noted previously, inadequate returns of the weekly fishing logs were obtained from rod-and-reel anglers fishing in the upper Aniak River, which prevented the successful estimation of fishery parameters associated with the portion of the fishery upstream of the Buckstock River.

LOWER RIVER FISHERY ESTIMATES

Angler Effort

An estimated total of 7,789 angler-hours (SE=932) were expended by anglers fishing downstream of the Buckstock River from 22 June to 28 August 2001, which fell well within the preseason precision criterion to estimate rod-and-reel effort within a relative precision of ±35 percent of the true value 80 percent of the time (Table 7). Anglers spent slightly more effort fishing in the section downstream of Doestock Creek (4,116 angler-hours) compared to the area between Doestock Creek and the Buckstock River (3,673 angler-hours). The observed relative precision for the estimates of angler effort for the area downstream of the Doestock Creek and waters between the Doestock Creek and the Buckstock River were both within the preseason precision criterion (±25 percent and ±17 percent, respectively).

Overall completed-trip anglers averaged 6 hours and 34 minutes of fishing per day downstream of the Buckstock River. Anglers who fished between the Buckstock River and Doestock Creek fished almost two hours more than anglers who fished downstream of the Doestock Creek, averaging about 7 hours and 38 minutes compared to 5 hours and 50 minutes per day. The estimates of effort in angler-days indicated that about 706 days were expended fishing in the lower and 481 in the upper survey reaches, for a total of 1,187 angler-days of effort (SE=146) between 22 June and 28 August (Table 7).

Table 6.-Aerial survey of angler effort, boat composition and locations of the upper Aniak River, upstream of Buckstock River, during June 25-August 26, 2001.

			Effort Counts		Boat and Aircraft Counts				Effort Counts by Locations		
					Boat Types and Aircraft						
Survey Event	Sample Week	Survey Date	Number of Anglers	Number of Boats	Prop	Jet	Raft	Planes	Aniak River	Salmon River	Aniak Lake
1	June 25-July 1	June 27	8	4	0	0	4	0	4	0	0
2	July 2- July 8	July 6	6	2	0	0	2	0	2	0	0
3	July 9-July15	July 11[a]	2	0				1	2		
		July 12	6	2	0	0	2	0	0	0	2
		July 14[a]	9	2			2			2	
4	July16-July 22	July 16[a]	9	2						2	
		July 17	36	12	2	1	9	0	6	6	0
5	July 23-July 29	Poor Weather									
6	July 30-Aug 5	July 31	4	2	0	0	2	0	0	2	0
7	Aug 6-Aug 12	Poor Weather									
8	Aug 13-Aug 19	August 16	28	10	0	0	10	0	16	10	2
9	Aug 20-Aug 26	August 24	27	10	0	1	9	0	15	12	0[b]

[a] Volunteer information from Aniak commercial air charter services.

[b] Party of five believed to be caribou hunting, no boats present at camp.

Table 7.-Angler effort in angler-hours and angler-days, standard errors, relative precision, and 80% confidence intervals for the rod-and-reel fishery downstream of the Buckstock River in the Aniak River between 22 June and 28 August, 2001.

	Angler Effort in Angler-hours				Angler Effort in Angler-days (approximate)[a]			
Survey Section	Hours	Standard Error	Relative Precision (at 80% level)	80% Confidence Interval	Days	Standard Error	Relative Precision (at 80% level)	80% Confidence Interval
Downstream of Doestock Creek (to the mouth of the Aniak River)	4,116	795	±25%	3,097-5,135	706`	130	±24%	539-872
Upstream of Doestock Creek (to Buckstock River)	3,673	486	±17%	3,050-4,206	481	66	±18%	396-565
Total (Downstream of the Buckstock River)	7,789	932	±15%	6,595-8,983	1,187	146	±16%	1,000-1,374

[a] Estimates of angler-days are only approximate due to the necessity of restricting the calculations to interviews of anglers that have completed their fishing trip for the day (see the Data Analysis section for additional details).

Harvest and Catch

By combining both survey sections there were twenty separate estimates of harvest and catch by species, of these only five separate estimates of catch by species met the preseason precision criterion of ±35% percent, 80% of the time (Table 8). None of the estimates of harvest by species met the preseason precision criterion of ±50% percent. Comparatively, only two estimates of catch by species without combining the survey sections met the preseason precision criterion: coho salmon downstream of Doestock Creek and Arctic grayling between Buckstock River and Doestock Creek (Tables 9 and 10).

Salmon

Estimates of salmon harvested in the Aniak River rod-and-reel fishery downstream of the Buckstock River were less precise than the preseason precision criterion (i.e., ± 50% percent, 80% of the time, see Table 8). Chum salmon were never observed as being harvested in the rod-and-reel fishery, and hence the estimated chum harvest was zero. All other estimates of salmon harvested in the rod-and-reel fishery were small in magnitude with relatively large standard errors. Most of the salmon harvested downstream of the Buckstock River were caught in the area downstream of Doestock Creek (Tables 9 and 10). Estimates of salmon catch between study sections were very similar, with the exception that more coho salmon, were caught downstream of Doestock Creek.

Resident Fish

Harvest of resident fish species in the rod-and-reel fishery downstream of the Buckstock River were substantially less precise than the preseason criterion of ±50% percent 80% of the time (Tables 8, 9, and 10). Downstream of the Buckstock River the rod-and-reel fishery harvest of resident fish species was composed primarily of Arctic grayling at 21 fish (SE=18), and the harvest of sheefish representing the next largest resident fish harvest at 7 fish (SE=7) downstream of the Buckstock River.

Estimates of the catch of Dolly Varden, Arctic grayling, and northern pike were all within the preseason precision criterion of ± 35% percent (80% of the time) for the fishery downstream of the Buckstock River (Table 8). The 80% confidence interval for catches of Dolly Varden, Arctic grayling, and northern pike ranged from approximately zero to 2,200 fish and point estimates were between approximately 1,000 to 1,600 fish.

Angler Demographics

Overall, most interviews were collected from guided (74%) nonresident (73%) men (92%) anglers (Table 11). Twenty-seven percent of the interviews were collected from Alaskan residents, and 24% from anglers who lived in the local area, mainly the community of Aniak. Most anglers gained access by boat (88%). The remaining 12% of interviews were collected from people who walked to fishing sites (usually “town beach”). It was more common to find more local Alaskans fishing near the village of Aniak, downstream of Doestock Creek. Most boat-based angling occurred from anchored boats. Approximately 70% of the anglers were using lures or spinning tackle. Fly tackle was observed approximately 25% of the time and the use of bait was rarely observed.

Table 8.-Harvest and catch of salmon and resident fish species, standard errors, relative precision, and 80% confidence intervals for the rod-and-reel fishery downstream of the Buckstock River in the Aniak River between 22 June and 28 August, 2001.

	Harvest				Catch			
Species	Number of Fish	Standard Error	Relative Precision (at 80% level)	80% Confidence Interval	Number of Fish	Standard Error	Relative Precision (at 80% level)	80% Confidence Interval
Salmon								
Chinook	82	61	±95%	3-160	1,860	664	±46%	3-2,710
Coho	917	439	±62%	85-1,479	4,369	969	±28%	85-5,609
Chum	0	0	0	0	5,464	1,424	±33%	0-7,287
Sockeye	10	5	±64%	0-16	13	6	±59%	0-21
Pink	49	25	±65%	0-81	49	25	±65%	0-81
Resident Fish								
Rainbow Trout	0	0	0	0	1,151	352	±40%	0-1,602
Dolly Varden	0	0	0	0	1,618	402	±32%	12-2,133
Arctc Grayling	21	18	±110%	3-44	1,467	325	±28%	3-1,883
Northern Pike	0	0	0	0	934	185	±26%	0-1,171
Sheefish	7	6	±110%	0-15	127	46	±46%	0-186

Table 9.-Harvest and catch of salmon and resident fish species, standard errors, relative precision, and 80% confidence intervals for the rod-and-reel fishery downstream of Doestock Creek to the mouth of the Kuskokwim River in the Aniak River between 22 June and 28 August, 2001.

	Harvest				Catch			
Species	Number of Fish	Standard Error	Relative Precision (at 80% level)	80% Confidence Interval	Number of Fish	Standard Error	Relative Precision (at 80% level)	80% Confidence Interval
Salmon								
Chinook	82	61	±95%	3-160	1,045	542	±67%	3-1,739
Coho	912	439	±61%	85-1,474	3,004	764	±32%	85-3,982
Chum	0	0	0	0	2,952	1,051	±46%	0-4,297
Sockeye	10	5	±63%	0-16	13	6	±59%	0-21
Pink	49	25	±65%	0-81	49	25	±65%	0-81
Resident Species								
Rainbow Trout	0	0	0	0	561	265	60%	0-900
Dolly Varden	0	0	0	0	628	257	52%	12-957
Arctic Grayling	0	0	0	0	698	264	49%	3-1,036
Northern Pike	0	0	0	0	383	138	46%	0-560
Sheefish	0	0	0	0	55	34	79%	0-99

Table 10.-Harvest and catch of salmon and resident fish species, standard errors, relative precision, and 80% confidence intervals for the rod-and-reel fishery between Buckstock River and Doestock Creek in the Aniak River between 22 June and 28 August, 2001.

	Harvest				Catch			
Species	Number of Fish	Standard Error	Relative Precision (at 80% level)	80% Confidence Interval	Number of Fish	Standard Error	Relative Precision (at 80% level)	80% Confidence Interval
Salmon								
Chinook	0	0	0	0	816	383	±60%	0-1,306
Coho	5	6	±154%	0-13	1,364	595	±56%	0-2,126
Chum	0	0	0	0	2,512	960	±49%	0-3,741
Sockeye	0	0	0	0	0	0	0	0
Pink	0	0	0	0	0	0	0	0
Resident Fish								
Rainbow Trout	0	0	0	0	590	231	±50%	0-886
Dolly Varden	0	0	0	0	990	309	±40%	12-1,386
Arctic Grayling	21	18	±110%	3-44	770	189	±32%	3-1,012
Northern Pike	0	0	0	0	71	32	±58%	0-112
Sheefish	7	6	±110%	0-15	127	46	±46%	0-186

Table 11.-Percentages of angler demographics observed downstream of the Buckstock River during the Aniak River rod-and-reel survey 22 June through 28 August 2001.

Angler Characteristics	Buckstock River to Doestock Creek	Doestock Creek to Kuskokwim River	Combined Sections
Angler Type	%	%	%
Guided	90	60	74
Unguided	10	40	26
Residency			
Alaskan	11	40	27
Non-Resident	89	60	73
Local	11	34	24
Non-Local	89	66	76
Gender			
Men	96	93	92
Women	4	7	8
Age			
Adult	98	95	96
Youth	2	5	4
Access			
Boat	86	90	88
Shore	14	10	12

The composition of guided to unguided anglers was substantially different downstream of the Doestock Creek. A third of the interviewed anglers downstream of the Doestock Creek were local residents.

Biological Sampling

Very few harvested fish were observed during the survey. Accordingly, field staff collected very few age and length samples. A total of three (3) chinook salmon and Arctic grayling age and length samples were collected. Only twelve (12) Dolly Varden lengths were collected during the survey. However, 85 age and length samples were collected from the harvest of the coho salmon fishery.

The survey collected 85 lengths and 62 age samples during August. Approximately 54% of the coho observed and measured were males and the average length was 588 mm from mid eye to the fork in the tail.

Female coho salmon composed 42% of the fish sampled and had a mean mid eye to tail length of 551 mm (Table 12). Within the limited age sample, only 14% of the coho sampled were age 2.2 (years in freshwater and years in marine waters). Observed regeneration growth in scale patterns or unreadable scales were less than 10 and combined with unknown length samples. These age and length samples were most likely biased because rod-and-reel anglers tend to target larger coho salmon when they are abundant.

Table 12.-Mean mid-eye to fork lengths of coho salmon, by sex and age group, from the sport fishery in the Aniak River 22 June through 28 August 2001.

	Age Group			
	Unknown[a]	2.1	2.2	Total
Female				
Mean Length (mm)	561	545	575	551
SE	49	34	7	38
Sample Size	9	25	2	36
Percentage %	10.6%	29.5%	2.3%	42.4%
Males				
Mean Length (mm)	584	579	617	588
SE	49	33	22	39
Sample Size	11	25	10	46
Percentage %	12.9%	29.4%	11.8%	54.1%
All Samples				
Mean Length (mm)	575	562	610	572
SE	49	37	26	42
Sample Size	23	50	12	85
Percentage %	27%	58.8%	14.1%	100%

[a] No scale sample collected.

DISCUSSION

OVERVIEW

Two unexpected conditions apparently affected the results of the survey of the rod-and-reel fishery in the Aniak River during 2001. Extremely high water conditions throughout the months of June, July, and August restricted rod-and-reel fishing in the Aniak River to such an extent that most local anglers apparently fished other local streams. Additionally, a Special Action issued by the Federal Subsistence Board restricted participation to federally qualified subsistence fishers in the chinook and chum salmon fisheries during June and July in waters under federal jurisdiction in the Yukon Delta Wildlife Refuge. The combination of these conditions likely resulted in substantially lower levels of angler participation than would have otherwise been observed, which resulted in effort, catch, and harvest parameters being estimated less precisely than the preseason criteria established for the survey. In particular estimates of the age, sex, and length composition of fish harvested in the lower Aniak River with rod-and-reel were quite imprecise due to the few numbers of harvested fish observed. Additionally, insufficient numbers of volunteer weekly fishing logs were returned above the Buckstock River to provide meaningful estimates.

Since most of the estimates from this survey were substantially less precise than criteria established for the survey, these estimates **should <u>not</u> be treated as being more reliable estimates of effort, harvest, and catch in the rod-and-reel fishery of the Aniak River than they actually were.** However, survey results may be useful in establishing a rough baseline (approximately accurate at gross levels of comparison) for the fishery during the summer of 2001 in comparison to results from previous surveys.

ANGLER DEMOGRAPHICS

Sport anglers (i.e., non-local anglers) comprised approximately 76% of the interviewed participants.

The findings in this study (Table 11) were similar to the findings reported by Dunaway (1997). There was an appreciable difference in composition between the two study sections in regards to local versus non-local participation by anglers. Downstream of Doestock Creek 34% of the anglers interviewed were local, whereas in the fishery between Doestock Creek and Buckstock River only 11% were local anglers. Apparently local anglers did not travel far for rod-and-reel fishing opportunities during 2001. This was confirmed in the weekly aerial surveys, in which very few boats traveling upstream of the Buckstock River (Table 6).

Guided versus unguided angler composition was similar to the local and non-local composition during the survey. Guided effort downstream of Doestock Creek was close to an even split, with guided anglers comprising 60 percent of the anglers interviewed.

Comparatively, guided anglers comprised the vast majority of interviews (90%) in the waters between the Buckstock River and Doestock Creek. This supported the supposition that local anglers, who do not use guides as often as non-locals, did not travel far during this survey period for rod-and-reel fishing opportunities.

ANGLER EFFORT

The on-site survey was primarily conducted during the period of late June through the end of August when most of the rod-and-reel fishing usually is conducted by both subsistence and sport anglers. Comparatively, the estimated number of angler-days of 1,187 (Table 7) for both user groups represented an apparent reduction in comparison to the recent 3-year average number of angler-days (3,600) reported by the SWHS (Table 1). Local anglers participating in the fishery under rod-and-reel subsistence regulations expended about 23% of the angler-days, and the remaining 77% of the angler-days were expended by non-local anglers participating in the sport fishery. These low estimates of effort were likely attributable to high and turbid water conditions throughout the survey period. Support for this supposition was provided during conversations with anglers during the interview process, which indicated that local anglers were not fishing the Aniak River as frequently as they did in the past. Additionally, non-qualified subsistence anglers were likely restricted from fishing for chinook and chum salmon by Federal Subsistence Board actions during June and July in waters under federal jurisdiction in the Yukon Delta Wildlife Refuge.

HARVEST AND CATCH

The relatively poor precision of both the harvest and catch estimates in the waters between the Buckstock River - Doestock Creek and downstream of Doestock Creek to the confluence of the Kuskokwim River can only provide rough indications of harvest and catch trends (Tables 8, 9, and 10).

Salmon

The weekly aerial surveys upstream of the Buckstock River indicated that few anglers participated in the 2001 fishery indicating that most of the salmon harvested by rod-and-reel occurred in the lower reaches of the Aniak River during 2001. Most of the salmon were harvested downstream of the Doestock Creek in the Aniak River during this survey. There was no discernable difference between catches of chinook and chum salmon between the sections, however the coho catch was apparently higher downstream of Doestock Creek during the survey (Tables 8, 9, and 10).

Although estimates of salmon harvest and catch were not as precise as preseason criteria, the trends of mean catch follow the increasing trends during expected periods of salmon passage. The mean CPUE of chinook salmon increased in the section downstream of the Doestock Creek towards the spawning season closure of July 26 (Appendix A1). Mean CPUE for chinook salmon in the waters between Doestock Creek and the Buckstock River remained stable during the month of July. Mean coho salmon CPUE exhibited increasing trends throughout the mouth of August in both sections downstream of Buckstock River indicating increased passage of coho through the lower Aniak River(Appendix A2). These trends of increasing mean CPUE were indicators that the survey was representative of the trends in the fishery. Chum salmon rod-and-reel catches increased up to mid-July and gradually declined during the remainder of the survey downstream of Doestock Creek (Appendix A3). This roughly coincided with sonar counts of chum salmon by day for 2001 (Appendix B1). These estimated salmon catches were very similar in magnitude to those reported by the SWHS and summarized in the area management report by Lafferty (*In press*).

Resident Species

During 22 June through 28 August 2001, the rod-and-reel fishing downstream of the Buckstock River did not harvest any resident fish species (Table 8).

Unexpectedly the local anglers who comprised 34% of the interviews downstream of the Doestock Creek (Table 11), did not harvest a single resident fish species during this survey (Table 9). The catch estimates of resident fish were only appreciably different for northern pike downstream of the Doestock Creek and sheefish between Buckstock River and Doestock Creek. The catches of rainbow trout, Dolly Varden, and Arctic grayling were consistent between the two sections downstream of the Buckstock River. It appeared that local residents of the Aniak area participate in catch-and-release practices for resident fish species in the lower Aniak River or they harvested so few fish that none were observed during this survey.

CONCLUSIONS AND RECOMMENDATIONS

1. **Most estimates of the 2001 effort, harvest and catch in the lower rod-and-reel fisheries of Aniak River did not meet the criteria for precision and therefore are not as reliable as hoped for.** Only a handful of the estimates met the wide objective criteria of the survey design.
2. Small remote fisheries of this type are difficult to assess even with a large sampling fraction. Any future plans for on-site surveys of the rod-and-reel effort, harvest, and catch in the Aniak River fisheries should not be undertaken unless an increase in expenditures and effort to sample the fishery are available.
3. Future sampling designs may need to involve stratification by day of the week (between weekday and weekend) since many local people work during the week and conduct their subsistence and recreational activities on weekends.

ACKNOWLEDGMENTS

This has been a cooperative project with Federal Office of Subsistence Management who provided $113,700 in funding support for this study under the Federal Subsistence Monitoring Program, under agreement number 701811J333. Capacity building is a priority for OSM, and this project was funded in part because of its capacity building component. We thank the field staff: John Warneke, Tim Chamberlin, and Buddy Morgan for their assistance throughout the survey and field work. Wayne Morgan of Kuskokwim Native Association (KNA) was instrumental during planning, field operations, report preparation, and building local support for this survey. Additionally, the local support of members of KNA, Aniak Tribal Council, local residents, and the sport fishing industry were greatly appreciated. We thank Jim Pagel for his logistical assistance with field staff and equipment during late June. Finally, we thank Bob Chadwick for review of this report.

LITERATURE CITED

AAC (Alaska Administrative Code). 2001a. 5 AAC 75.013. In Alaska Fish and Game Laws and Regulations Annotated 2000-2001 edition. Lexis Publishing, New York.

AAC (Alaska Administrative Code). 2001b. 5 AAC 01.295. In Alaska Fish and Game Laws and Regulations Annotated 2000-2001 edition. Lexis Publishing, New York.

LITERATURE CITED (Continued)

AAC (Alaska Administrative Code). 2001c. 5 AAC 01.270(l). In Alaska Fish and Game Laws and Regulations Annotated 2000-2001 edition. Lexis Publishing, New York.

Bernard, D. R., A. E. Bingham and M. Alexandersdottir. 1998. The mechanics of onsite creel surveys in Alaska. Alaska Department of Fish and Game, Special Publication No. 98-1, Anchorage.

Burkey, C., M. Coffing, J. Menard, D. B. Molyneaux, P. Salomone, and C. Utermohle. 2001. Annual management report for the subsistence and commercial fisheries of the Kuskokwim area, 2000. Alaska Department of Fish and Game, Division of Commercial Fisheries. Regional Information Report No. 3A01-34.

Chilton, D. E. and R. J. Beamish. 1982. Age determination methods for fish studied by the Groundfish Program at Pacific Biological Station. Canadian Special Publication of Fisheries and Aquatic Sciences, number 60.

Cochran, W. G. 1977. Sampling techniques, third edition. John Wiley and Sons, New York.

DiCostanzo, C. J. 1956. Creel census techniques and harvest of fishes in Clear Lake, Iowa. Ph. D. dissertation, Iowa State College, Ames, Iowa.

Dunaway, D. O. 1997. Monitoring the sport fisheries of the Aniak River, Alaska, 1996. Alaska Department of Fish and Game, Fishery Management Report No. 97-4, Anchorage.

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., R. J. Walker, C. Olnes, K. Sundet, and A. E. Bingham. 2001a. Revised Edition: Harvest, catch, and participation in Alaska sport fisheries during 1996. Alaska Department of Fish and Game, Fishery Data Series 97-29 (revised), 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 1997. Alaska Department of Fish and Game, Fishery Data Series 98-25 (revised), Anchorage.

Howe, A. L., R. J. Walker, C. Olnes, K. Sundet, and A. E. Bingham. 2001c. Revised Edition: Participation, catch, and harvest in Alaska sport fisheries during 1998. Alaska Department of Fish and Game, Fishery Data Series 99-41 (revised), Anchorage.

Howe, A. L., G. Fidler, C. Olnes, A. E. Bingham, and M. J. Mills. 2001d. Participation, catch, and harvest in Alaska sport fisheries during 1999. Alaska Department of Fish and Game, Fishery Data Series 01-8, Anchorage.

Jearld, A., Jr. 1983. Age determination. Pages 301-324 in L. A. Nielsen, editors. Fisheries techniques. The American Fisheries Society, Bethesda, Maryland.

Lafferty, R. *In press.* Fishery management report for the sport fisheries in the lower Yukon and lower Kuskokwim management area for 2000. Alaska Department of Fish and Game, Fishery Management Report, Anchorage.

Lux, F. E. 1971. Age determination of fishes (revised). National Marine Fisheries Service. Fishery Leaflet 637. Seattle, Washington.

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.

LITERATURE CITED (Continued)

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.

Sokal, R. R., and F. J. Rohlf. 1981. Biometry, second edition. W. H. Freeman and Company, New York.

Thompson, S. K. 1992. Sampling. John Wiley and Sons, 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.

Walker, R. J., C. Olnes, K. Sundet, A. L. Howe, and A. E. Bingham. *In prep*. Participation, catch, and harvest in Alaska sport fisheries during 2000. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.

Wolter, K. M. 1985. Introduction to variance estimation. Springer-Verlag, New York.

APPENDIX A
SURVEY SUMMARY STATISTICS AND ESTIMATES OF HARVEST AND CATCH BY SPECIES.

Appendix A1.-Survey summary statistics and estimates of effort (angler-hours), harvest and catch of chinook salmon by rod-and-reel in the Aniak River, downstream of the Buckstock River, 22 June through 28 August 2001.

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Chinook Salmon – Upper Section – Buckstock River to Doestock Creek, Aniak River									
22 - 30 June	3	3	23	0.0	0.0	0	0.20833	0.02257	5
1 - 9 July	3	4	405	0.0	0.0	0	0.47917	0.04408	194
10 - 18 July	3	8	480	0.0	0.0	0	0.64509	0.16415	310
19 - 28 July	3	10	983	0.0	0.0	0	0.31250	0.10233	307
29 July - 4 August	3	19	813	0.0	0.0	0	0.0	0.0	0
5-28 August	7	3	969	0.0	0.0	0	0.0	0.0	0

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Chinook Salmon - Lower Section – Doestock Creek to the mouth of the Kuskokwim River, Aniak River									
22 - 30 June	3	3	75	0.0	0.0	0	0.54167	0.00174	41
1 - 9 July	3	4	218	0.37500	0.06324	82	0.65625	0.08291	143
10 - 18 July	3	8	690	0.0	0.0	0	0.60714	0.15300	419
19 - 25 July	3	5	700	0.0	0.0	0	0.62500	0.39063	438
26 July - 2 August	3	23	453	0.0	0.0	0	0.01087	0.00006	5
3 - 10 August	3	3	773	0.0	0.0	0	0.0	0.0	0
11 - 15 August	3	14	817	0.0	0.0	0	0.0	0.0	0
16 - 28 August	5	7	390	0.0	0.0	0	0.0	0.0	0

Appendix A2.-Survey summary statistics and estimates of effort (angler-hours), harvest and catch of coho salmon by rod-and-reel in the Aniak River, downstream of the Buckstock River, 22 June through 28 August 2001.

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Coho Salmon - Upper Section – Buckstock River to Doestock Creek, Aniak River									
22 - 30 June	3	3	23	0.0	0.0	0	0.0	0.0	0
1 - 9 July	3	4	405	0.0	0.0	0	0.0	0.0	0
10 - 18 July	3	8	480	0.0	0.0	0	0.0	0.0	0
19 - 28 July	3	10	983	0.0	0.0	0	0.03750	0.00074	37
29 July - 4 August	3	19	813	0.00658	0.00005	5	0.11623	0.00154	95
5 - 28 August	7	3	969	0.0	0.0	0	1.27183	0.34015	1,233

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Coho Salmon - Lower Section – Doestock Creek to the mouth of the Kuskokwim River, Aniak River									
22 - 30 June	3	3	75	0.0	0.0	0	0.0	0.0	0
1 – 9 July	3	4	218	0.0	0.0	0	0.0	0.0	0
10 - 18 July	3	8	690	0.0	0.0	0	0.0	0.0	0
19 - 25 July	3	5	700	0.0	0.0	0	0.0	0.0	0
26 July- 2 August	3	23	453	0.0	0.0	0	0.05435	0.00033	25
3 - 10 August	3	3	773	0.0	0.0	0	0.62500	0.0	483
11 - 15 August	3	14	817	0.40051	0.04570	327	1.67344	0.10327	1,367
16 - 28 August	5	7	390	1.50000	0.53993	585	2.89683	0.48481	1,130

Appendix A3.-Survey summary statistics and estimates of effort (angler-hours), harvest and catch of chum salmon by rod-and-reel in the Aniak River, downstream of the Buckstock River, downstream of the Buckstock River, 22 June through 28 August 2001.

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Chum Salmon - Upper Section – Buckstock River to Doestock Creek, Aniak River									
22-30 June	3	3	23	0.0	0.0	0	0.08333	0.00694	2
1 – 9 July	3	4	405	0.0	0.0	0	0.46875	0.31820	190
10 - 18 July	3	8	65	0.0	0.0	0	1.22321	0.56805	587
19 - 28 July	3	10	983	0.0	0.0	0	0.79583	0.32741	783
29 July - 4 August	3	19	813	0.0	0.0	0	0.57237	0.01503	466
5 - 28 August	7	3	969	0.0	0.0	0	0.50000	0.37255	485

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Chum Salmon - Lower Section – Doestock Creek to the mouth of the Kuskokwim River, Aniak River									
22 - 30 June	3	3	75	0.0	0.0	0	0.25000	0.0	19
1 - 9 July	3	4	218	0.0	0.0	0	0.46875	0.30684	102
10 - 18 July	3	8	690	0.0	0.0	0	1.07366	0.51413	741
19 - 25 July	3	5	700	0.0	0.0	0	1.15000	1.32250	805
26 July - 2 August	3	23	453	0.0	0.0	0	0.27717	0.00278	126
3 - 10 August	3	3	773	0.0	0.0	0	1.50000	0.0	1,160
11 - 15 August	3	14	817	0.0	0.0	0	0.0	0.0	0
16 - 28 August	5	7	390	0.0	0.0	0	0.0	0.0	0

Appendix A4.-Survey summary statistics and estimates of effort (angler-hours), harvest and catch of sockeye salmon by rod-and-reel in the Aniak River, downstream of the Buckstock River, downstream of the Buckstock River, 22 June through 28 August 2001.

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Sockeye Salmon - Upper Section – Buckstock River to Doestock Creek, Aniak River									
22 - 30 June	3	3	23	0.0	0.0	0	0.0	0.0	0
1 - 9 July	3	4	405	0.0	0.0	0	0.0	0.0	0
10 - 18 July	3	8	65	0.0	0.0	0	0.0	0.0	0
19 - 28 July	3	10	983	0.0	0.0	0	0.0	0.0	0
29 July - 4 August	3	19	813	0.0	0.0	0	0.0	0.0	0
5 - 28 August	7	3	969	0.0	0.0	0	0.0	0.0	0

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Sockeye Salmon - Lower Section – Doestock Creek to the mouth of the Kuskokwim River, Aniak River									
22 - 30 June	3	3	75	0.0	0.0	0	0.04167	0.00174	3
1 - 9 July	3	4	218	0.0	0.0	0	0.0	0.0	0
10 - 18 July	3	8	690	0.0	0.0	0	0.0	0.0	0
19 - 25 July	3	5	700	0.0	0.0	0	0.0	0.0	0
26 July - 2 August	3	23	453	0.0	0.0	0	0.02174	0.00005	10
3 - 10 August	3	3	773	0.0	0.0	0	0.0	0.0	0
11 - 15 August	3	14	817	0.0	0.0	0	0.0	0.0	0
16 - 28 August	5	7	390	0.0	0.0	0	0.0	0.0	0

Appendix A5.-Survey summary statistics and estimates of effort (angler-hours), harvest and catch of pink salmon by rod-and-reel in the Aniak River, downstream of the Buckstock River, downstream of the Buckstock River, 22 June through 28 August 2001.

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Pink Salmon - Upper Section – Buckstock River to Doestock Creek, Aniak River									
22 - 30 June	3	3	23	0.0	0.0	0	0.0	0.0	0
1 - 9 July	3	4	405	0.0	0.0	0	0.0	0.0	0
10 - 18 July	3	8	65	0.0	0.0	0	0.0	0.0	0
19 - 28 July	3	10	983	0.0	0.0	0	0.0	0.0	0
29 July - 4 August	3	19	813	0.0	0.0	0	0.0	0.0	0
5 - 28 August	7	3	969	0.0	0.0	0	0.0	0.0	0

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Pink Salmon - Lower Section – Doestock Creek to the mouth of the Kuskokwim River, Aniak River									
22 - 30 June	3	3	75	0.0	0.0	0	0.0	0.0	0
1 - 9 July	3	4	218	0.0	0.0	0	0.0	0.0	0
10 - 18 July	3	8	690	0.0	0.0	0	0.0	0.0	0
19 - 25 July	3	5	700	0.0	0.0	0	0.0	0.0	0
26 July - 2 August	3	23	453	0.10870	0.00137	49	0.10870	0.00137	49
3 - 10 August	3	3	773	0.0	0.0	0	0.0	0.0	0
11 - 15 August	3	14	817	0.0	0.0	0	0.0	0.0	0
16 - 28 August	5	7	390	0.0	0.0	0	0.0	0.0	0

Appendix A6.-Survey summary statistics and estimates of effort (angler-hours), harvest and catch of rainbow trout by rod-and-reel in the Aniak River, downstream of the Buckstock River, 22 June through 28 August 2001.

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Rainbow Trout - Upper Section – Buckstock River to Doestock Creek, Aniak River									
22 - 30 June	3	3	23	0.0	0.0	0	0.16667	0.01215	4
1 - 9 July	3	4	405	0.0	0.0	0	0.15625	0.03536	63
10 - 18 July	3	8	65	0.0	0.0	0	0.41518	0.04048	199
19 - 28 July	3	10	983	0.0	0.0	0	0.20833	0.02281	205
29 July - 4 August	3	19	813	0.0	0.0	0	0.01316	0.00009	11
5 - 28 August	7	3	969	0.0	0.0	0	0.11111	0.01332	108

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Rainbow Trout - Lower Section – Doestock Creek to the mouth of the Kuskokwim River, Aniak River									
22 - 30 June	3	3	75	0.0	0.0	0	0.37500	0	28
1 - 9 July	3	4	218	0.0	0.0	0	0.18750	0.02937	41
10 - 18 July	3	8	690	0.0	0.0	0	0.30134	0.03678	208
19 - 25 July	3	5	700	0.0	0.0	0	0.30000	0.09000	210
26 July - 2 August	3	23	453	0.0	0.0	0	0.02174	0.00012	10
3 - 10 August	3	3	773	0.0	0.0	0	0.08333	0.00174	64
11 - 15 August	3	14	817	0.0	0.0	0	0.0	0.0	0
16 - 28 August	5	7	390	0.0	0.0	0	0.0	0.0	0

Appendix A7.-Survey summary statistics and estimates of effort (angler-hours), harvest and catch of Dolly Varden by rod-and-reel in the Aniak River, downstream of the Buckstock River, 22 June through 28 August 2001.

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Dolly Varden - Upper Section – Buckstock River to Doestock Creek, Aniak River									
22 - 30 June	3	3	23	0.0	0.0	0	0.20833	0.02257	5
1 - 9 July	3	4	405	0.0	0.0	0	0.25000	0.03720	101
10 - 18 July	3	8	65	0.0	0.0	0	0.50223	0.04074	241
19 - 28 July	3	10	983	0.0	0.0	0	0.25000	0.01904	246
29 July - 4 August	3	19	813	0.0	0.0	0	0.22368	0.00116	182
5 - 28 August	7	3	969	0.0	0.0	0	0.22222	0.05327	215

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Dolly Varden - Lower Section – Doestock Creek to the mouth of the Kuskokwim River, Aniak River									
22 - 30 June	3	3	75	0.0	0.0	0	0.50000	0.0	38
1- 9 July	3	4	218	0.0	0.0	0	0.25000	0.03600	54
10 - 18 July	3	8	690	0.0	0.0	0	0.26563	0.03450	183
19 - 25 July	3	5	700	0.0	0.0	0	0.27500	0.07563	193
26 July - 2 August	3	23	453	0.0	0.0	0	0.21196	0.00062	96
3 - 10 August	3	3	773	0.0	0.0	0	0.08333	0.00694	64
11 - 15 August	3	14	817	0.0	0.0	0	0.0	0.0	0
16 - 28 August	5	7	390	0.0	0.0	0	0.0	0.0	0

Appendix A8.-Survey summary statistics and estimates of effort (angler-hours), harvest and catch of Arctic grayling by rod-and-reel in the Aniak River, downstream of the Buckstock River, 22 June through 28 August 2001.

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Arctic Grayling - Upper Section – Buckstock River to Doestock Creek, Aniak River									
22 - 30 June	3	3	23	0.0	0.0	0	0.29167	0.02257	7
1 - 9 July	3	4	405	0.0	0.0	0	0.34375	0.01118	139
10 - 18 July	3	8	65	0.0	0.0	0	0.29688	0.02625	143
19 - 28 July	3	10	983	0.0	0.0	0	0.25000	0.01429	246
29 July - 4 August	3	19	813	0.02632	0.00044	21	0.28947	0.00142	235
5 - 28 August	7	3	969	0.0	0.0	0	0.0	0.0	0

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Arctic Grayling - Lower Section – Doestock Creek to the mouth of the Kuskokwim River, Aniak River									
22 - 30 June	3	3	75	0.0	0.0	0	0.50000	0.0	38
1 - 9 July	3	4	218	0.0	0.0	0	0.34375	0.01116	75
10 - 18 July	3	8	690	0.0	0.0	0	0.21875	0.02326	151
19 - 25 July	3	5	700	0.0	0.0	0	0.22500	0.05063	158
26 July - 2 August	3	23	453	0.0	0.0	0	0.25543	0.00131	116
3 - 10 August	3	3	773	0.0	0.0	0	0.20833	0.04340	161
11 - 15 August	3	14	817	0.0	0.0	0	0.0	0.0	0
16 - 28 August	5	7	390	0.0	0.0	0	0.0	0.0	0

Appendix A9.-Survey summary statistics and estimates of effort (angler-hours), harvest and catch of northern pike by rod-and-reel in the Aniak River, downstream of the Buckstock River, 22 June through 28 August 2001.

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Northern Pike – Upper Section – Buckstock River to Doestock Creek, Aniak River									
22 - 30 June	3	3	23	0.0	0.0	0	0.62500	0.16146	14
1 - 9 July	3	4	405	0.0	0.0	0	0.37500	0.00680	152
10 - 18 July	3	8	65	0.0	0.0	0	0.12500	0.00749	60
19 - 28 July	3	10	983	0.0	0.0	0	0.08750	0.00217	86
29 July - 4 August	3	19	813	0.0	0.0	0	0.29386	0.00383	239
5 - 28 August	7	3	969	0.0	0.0	0	0.0	0.0	0

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Northern Pike - Lower Section – Doestock Creek to the mouth of the Kuskokwim River, Aniak River									
22 - 30 June	3	3	75	0.0	0.0	0	1.37500	0.0	103
1 - 9 July	3	4	218	0.0	0.0	0	0.37500	0.00703	82
10 - 18 July	3	8	690	0.0	0.0	0	0.06250	0.00401	43
19 - 25 July	3	5	700	0.0	0.0	0	0.0	0.0	0
26 July - 2 August	3	23	453	0.0	0.0	0	0.24457	0.00096	111
3 - 10 August	3	3	773	0.0	0.0	0	0.04167	0.00173	32
11 - 15 August	3	14	817	0.0	0.0	0	0.0	0.0	0
16 - 28 August	5	7	390	0.0	0.0	0	0.03175	0.00368	12

Appendix A10.-Survey summary statistics and estimates of effort (angler-hours), harvest and catch of sheefish by rod-and-reel in the Aniak River, downstream of the Buckstock River, 22 June through 28 August 2001.

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Sheefish - Upper Section – Buckstock River to Doestock Creek, Aniak River									
22 - 30 June	3	3	23	0.0	0.0	0	0.0	0.0	0
1 - 9 July	3	4	405	0.0	0.0	0	0.0	0.0	0
10 - 18 July	3	8	65	0.0	0.0	0	0.0	0.0	0
19 - 28 July	3	10	983	0.0	0.0	0	0.02917	0.00031	29
29 July - 4 August	3	19	813	0.00877	0.00005	7	0.05263	0.00075	43
5 - 28 August	7	3	969	0.0	0.0	0	0.0	0.0	0

Period	Days Sampled	Number of Interviews	Angler Hours	Mean Harvest Per Hour (HUPE)	Variance of Mean HUPE	Harvest	Mean Catch Per Hour (CPUE)	Variance of Mean CPUE	Catch
Sheefish - Lower Section – Doestock Creek to the mouth of the Kuskokwim River, Aniak River									
22 - 30 June	3	3	75	0.0	0.0	0	0.04167	0.00174	3
1 - 9 July	3	4	218	0.0	0.0	0	0.0	0.0	0
10 - 18 July	3	8	690	0.0	0.0	0	0.0	0.0	0
19 - 25 July	3	5	700	0.0	0.0	0	0.0	0.0	0
26 July - 2 August	3	23	453	0.0	0.0	0	0.04348	0.00025	20
3 - 10 August	3	3	773	0.0	0.0	0	0.04167	0.00174	32
11 - 15 August	3	14	817	0.0	0.0	0	0.0	0.0	0
16 - 28 August	5	7	390	0.0	0.0	0	0.0	0.0	0

APPENDIX B

HISTORICAL SALMON ESCAPEMENT FOR THE ANIAK RIVER.

Appendix B1.-Sonar counts of chum salmon passage in the Aniak River, 2001.

Date	Left Bank	Right Bank	Daily Total	Cumulative Total
July 1-11[a]				
July 12	1,654	6,522	8,175	8,175
July 13	2,463	6,650	9,113	17,288
July 14	4,055	10,072	14,127	31,415
July 15	4,455	9,361	13,816	45,231
July 16	3,578	8,688	12,266	57,497
July 17	3,470	8,816	12,286	69,783
July 18	4,053	10,284	14,337	84,120
July 19	3,608	8,535	12,143	96,263
July 20	3,439	6,680	10,119	106,383
July 21	5,756	10,769	16,525	122,908
July 22	5,476	9,012	14,488	137,396
July 23	4,783	7,129	11,912	149,308
July 24	4,083	6,485	10,568	159,876
July 25	3,753	5,675	9,428	169,304
July 26	3,805	4,991	8,796	178,099
July 27	3,676	5,899	9,575	187,674
July 28	4,081	4,677	8,758	196,432
July 29	3,788	4,649	8,437	204,869
July 30	3,611	3,654	7,266	212,135
July 31	2,412	2,817	5,229	217,364
August 1	2,169	2,698	4,867	222,231
Total	**78,168**	**144,063**	**222,231**	**222,231**

[a] Sonar project delayed on account of high water conditions in the Aniak River.

Appendix B2.-Historic salmon escapement estimates from the Aniak River sonar project, 1980-2001.

		Species				
Year	Operating Period	Chinook[a]	Sockeye[a]	Coho[a]	Pink[a]	Chum
Escapement Objective						**250,000**
Fixed beam sonar- one bank estimates						
1980	6/22 - 7/30	56,469				1,169,470
	8/16 - 9/12			81,556		
1981	6/16 - 8/06	42,060				589,286
1982	6/21 - 8/01	33,864				442,461
1983	6/18 - 7/28	4,911				129,367
1984	6/16 - 7/30					266,976
1985	6/22 - 7/28					253,051
1986	6/26 - 7/24					209,080
1987	6/22 - 7/31					193,013
1988	6/22 - 7/31					401,511
1989	6/21 - 7/24					243,922
1990	6/23 - 8/06					232,260
1991	6/29 - 7/29					314,166
1992	6/22 - 7/29					84,269
1993	6/24 - 7/28					13,870
1994	6/28 - 7/28					388,163
1995	6/23 - 7/23					[b]
User- configurable sonar, two-bank estimates						
1996	6/21 - 7/28					302,106
1997	6/16 – 8/03					265,522
1998	6/24 – 7/31					279,430
1999	7/01 – 8/03					177,771
2000	6/25 – 7/31					144,157
2001	7/12[c] – 8/01					222,231

Source: Burkey et. al. (2001;Table A7)

[a] No counts or incomplete counts; project was not operated during the species' migration.

[b] Reliable escapement estimates are not available.

[c] Delayed start of project on account of high water conditions.

Appendix B3.-History of aerial survey index counts of chinook salmon in the Aniak River drainage, 1975-2001.

Year	Aniak River	Kipchuk River[a]	Salmon River[a]
1975		94	
1976		177	
1977			562
1978			289
1980			1,186
1981	9,074		894
1982	2,645		185
1983	1,909		231
1984	1,409		
1985			
1986	909		336
1987		193	516
1988	945		244
1989	1,880	994	631
1990	1,255	537	596
1991	1,564	885	583
1992	2,284	670	335
1993	2,687	1,248	1,082
1994	1,848	1,520	1,218
1995	3,174	1,215	1,442
1996	3,496		983
1997	2,187	855	980
1998	2,239	353	
1999			
2000	714	182	152
2001			703

[a] Kipchuk and Salmon rivers are tributaries to the Aniak River drainage. Source: Burkey et al. 2001 (*In prep*).

APPENDIX C. DATA FILES AND COMPUTER PROGRAMS USED TO PRODUCE THIS REPORT

Appendix C1.-Data files and computer programs used to produce this report.

Data files (*.DTA) archived at Alaska Department of Fish and Game, Division of Sport Fish, Research and Technical Services Unit, 333 Raspberry Rd., Anchorage, AK 99518-1599.

Data Files

Angler count data:

V00500c012001a.dta 1st batch file of angler counts.

V00500c012001b.dta 2nd batch file of angler counts.

V00500c012001z.dta edited and complied batch files of angler counts.

Angler interview data:

V00500i012001a.dta 1st batch file of angler interviews.

V00500i012001b.dta 2nd batch file of angler interviews.

V00500i012001z.dta edited and complied batch files of angler interviews.

Biological data:

V0050b012001age.dta Aniak River chinook (3) coho (85) Dolly Varden (12) biological data

Coho 2001 AWL.dat Aniak River coho salmon sex, length and age data.

Coho 2001 AWL.xls Aniak River coho salmon sex, length and age spreadsheet.

Survey Summary files:

Surveydata2001.xls Aniak River survey data

Surveydataanalysisestimatesse.xls Aniak River spreadsheet of survey data analysis

ANK01ES2mod.doc Aniak River survey estimates

Analysis Programs

ANK01ES2mod.sas SAS program to calculate survey estimates.

ANK01ES3mod.sas SAS program to calculate angler-day estimates.