Fishery Data Series No. 05-23

Survey of the Chinook Salmon Sport Fishery in the Lower Nushagak River, Alaska, 2000

by

Jason E. Dye

June 2005

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

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Measures (fisheries)

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

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics (F, t, χ^2, etc.)	
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY DATA SERIES NO. 05-23

SURVEY OF THE CHINOOK SALMON SPORT FISHERY IN THE LOWER NUSHAGAK RIVER, ALASKA, 2000

by

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ABSTRACT

A survey of the sport fishery for Chinook salmon was conducted on the Nushagak River in Southwest Alaska from 15 June-25 July 2000. A total of 4,208 anglers associated with Choggiung Ltd. permitted commercial camps were interviewed for information on catch, harvest, use of guide service, and use of bait. Their catch was 13,248 Chinook salmon, of which 2,460 (19%) were harvested; 61% of those anglers used bait. A total of 202 anglers not associated with Choggiung Ltd commercial camps were interviewed for information on catch, harvest, effort, use of bait, use of guide services, and other angler demographics. These anglers caught 190 Chinook salmon and harvested 34 (18%); 97% of these anglers used spin gear, and 51% were non-Alaskan residents. Eighty-four percent of all angler trips were guided. Weekly CPUE ranged from 1.13 (SE = 0) to 4.42 (SE = 0.37) fish per angler-day. Weekly HPUE ranged from 0.19 (SE = 0) to 0.70 (SE =0.04) fish per angler day. Sport-harvested Chinook salmon were predominately age 1.4 (35%) followed by age 1.5 (34%). Overall average mid-eye to tail fork length (MEFL) was 796 mm. Fifty-six percent were males; mean weight of all was 9 kg.

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, Nushagak River, catch rates, harvest rates, angler characteristics, and biological composition.

INTRODUCTION

The Bristol Bay Management Area (BBMA) supports several important sport fisheries, notably in the Alagnak, Kvichak, Naknek, Nushagak, and Togiak rivers (Figure 1). The Nushagak River and its tributary the Mulchatna River host the largest and fastest growing Chinook salmon *Oncorhynchus tshawytscha* fisheries in the region. The local Alaska Native corporation, Choggiung Ltd., manages much of the land above mean high water adjoining the Nushagak River and requires all users of their lands, including commercial guide operations, to purchase a permit. Therefore, there are three distinct angler types on the river: commercially permitted, non-commercially permitted, and non-permitted anglers. For this project anglers were divided into two groups: commercially permitted and non-commercially permitted/non-permitted.

The Nushagak River is currently managed using the Nushagak-Mulchatna Chinook Salmon Management Plan (5 AAC 06.361, Appendix A1). Under normal run levels, the department manages the sport fishery such that harvest does not exceed 5,000 Chinook salmon annually. The plan outlines run projection levels at which restrictions are to be implemented to reduce the annual harvest or when the allocation may be exceeded. The Nushagak/Mulchatna sport fishery has demonstrated an ability to equal or exceed the allocation levels of the plan with harvest levels ranging from 4,951 fish in 1995 to 10,627 in 1994 (Table 1, Howe et al. 1996; Mills 1987-1994). To comply with the plan the department issued emergency order bag limit reductions before and during the 1996, 1997, and 1999 seasons (Dunaway and Sonnichsen 2001).

In 1998, new regulations went into effect to ensure that sport harvest is consistent with the plan (Dunaway et al. 2000). The sport fishery regulations stipulate, in part, an annual bag limit of 4 Chinook salmon and a daily bag limit of 2 Chinook salmon, only one of which may be > 710 mm (28 in) total length in the Nushagak River drainage (ADF&G 2000). The open season for Chinook salmon is 1 May through 31 July in the Nushagak River downstream from the outlet of the Iowithla River (ADF&G 2000). Upstream of the outlet of the Iowithla River, and including the Iowithla River, the open season is 1 May through 25 July (ADF&G 2000).

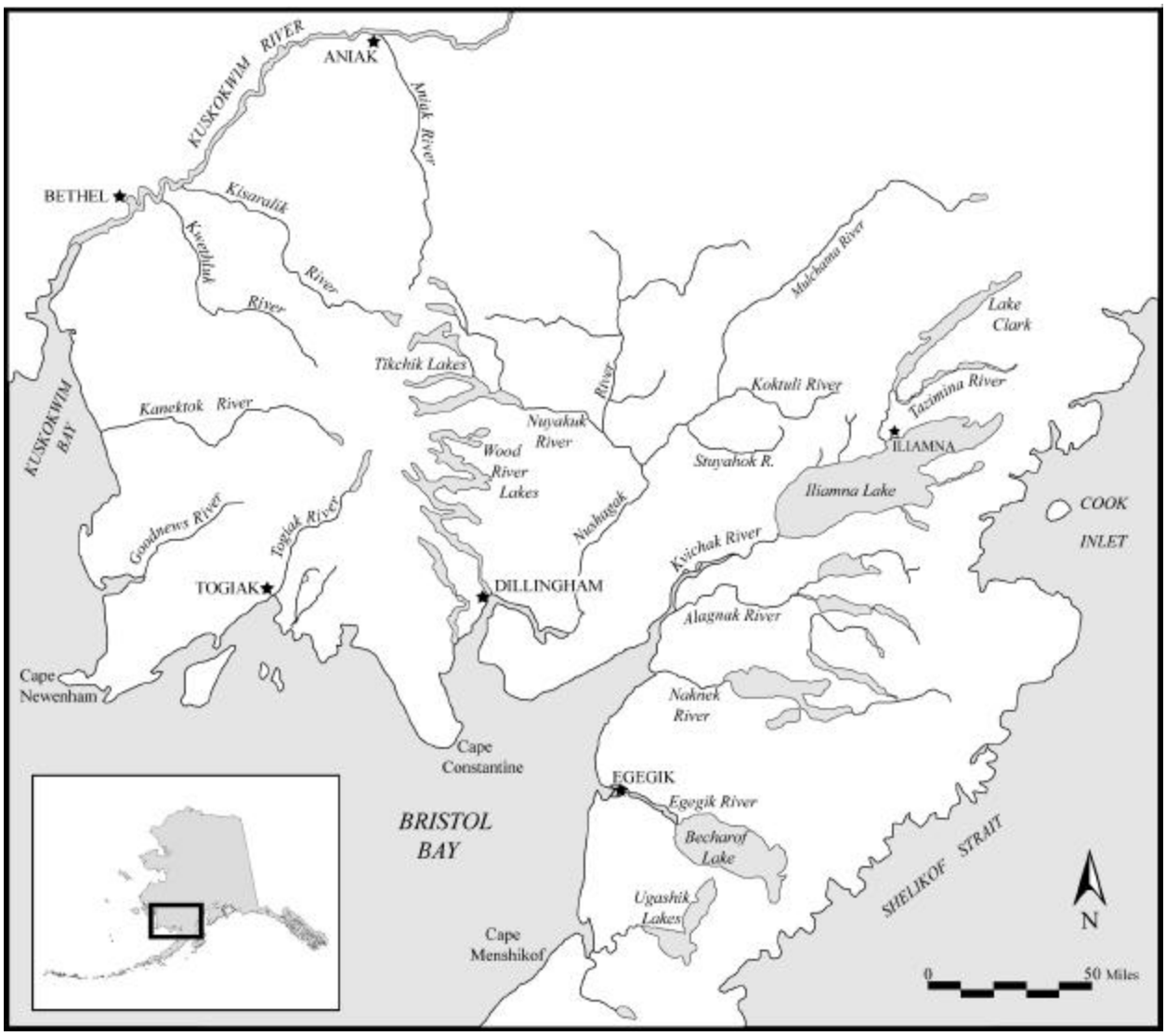

Figure 1.-Popular salmon fisheries in the Southwestern Alaska Management Area.

Data collected on sport fisheries in the Nushagak River drainage include effort, harvest and catch estimates from the annual Statewide Harvest Survey (Howe et al. 1995, 1996, 2001 a-d; Mills 1979-1980, 1981a-b, 1982-1994; Walker et al. 2003), and five onsite creel surveys conducted in 1985, 1986, 1987, 1991, and 1994 (Brandt and Minard 1985; Dunaway and Bingham 1992; Dunaway and Fleischman 1995; Minard 1987; Minard and Brookover 1988). A creel survey conducted in 1997 in the lower reaches of the Nushagak River and middle Mulchatna River was terminated early by a closure of the Chinook salmon fishery; results were briefly summarized in Minard et al. (1998). Additional information on the Mulchatna River sport fishery is limited to five creel surveys conducted in 1986,

Table 1.-Chinook salmon commercial, subsistence, and sport harvest plus escapement for the Nushagak drainage, 1986-2000.

		Harvests Below Sonar					Harvests Above Sonar		Spawning Escapement	
Year	Total Run	Commercial Harvest[a]	Commercial Subsistence Removals[b]	Subsistence Harvest[c]	Sport Harvest[d]	Inriver Sonar estimate	Subsistence Harvest[e]	Sport Harvest[f]	Sonar Estimate[g]	Aerial Survey Estimate[h]
1986	117,478	65,783	798	6,834	628	43,434	4,725	4,162	34,547	
1987	139,814	45,983	318	7,919	1,286	84,309	3,139	3,173	77,997	
1988	80,184	16,648	528	4,911	1,192	56,905	4,037	1,626	51,242	
1989	102,872	17,637	632	4,898	1,404	78,302	2,217	2,210	73,875	
1990	86,990	14,812	1,197	6,228	797	63,955	3,325	2,689	57,941	
1991	134,740	19,718	1,971	6,907	1,793	104,351	3,127	3,758	97,466	
1992	140,850	47,563	907	7,688	1,844	82,848	2,499	2,911	77,438	
1993	175,614	62,976	1,867	10,552	2,408	97,812	2,919	3,492	91,401	
1994	229,583	119,480	1,126	8,587	4,436	95,954	3,775	6,191	85,989	
1995	177,801	79,942	1,327	8,672	2,238	85,622	2,420	2,713	80,489	
1996	136,812	72,011	730	9,598	2,346	52,127	3,055	3,045	46,027	
1997	156,096	64,294	544	8,328	931	40,705	3,192	2,567		82,000
1998	234,107	108,486	805	5,682	1,640	117,495	4,440	4,188	108,868	
1999	79,973	10,893	927	4,888	934	62,331	2,477	3,304	56,551	
Average	142,351	53,302	977	7,264	1,705	76,154	3,239	3,287	72,295	
Average	156,958	67,125	866	7,434	1,617	71,656	3,117	3,163	72,984	
2000	75,172	12,055	1,052	4,302	1,389	56,374	2,132	4,628	49,615	

[a] Total Nushagak District commercial harvest. Sources: 1986-1998 Glick et al. 2000; 1999-2000 Weiland et al. 2001, Appendix Table 6.

[b] Nushagak Bay Commercial Harvest from Subsistence Division Subsistence Database. Source: ADF&G Subsistence Division, Subsistence Database from Charles Utermohle, Program Coordinator, Subsistence Division, Region II, Anchorage, November 20, 2000.

[c] Includes Nushagak Bay and Igushik. Source: ADF&G Subsistence Division, Subsistence Database from Charles Utermohle, Program Coordinator, Subsistence Division, Region II, Anchorage, November 20, 2000. Data for 2000 provided by James Fall, Subsistence Division, Region II, Anchorage.

[d] 1986-1996 is 50% of Nushagak River System sport harvest. 1997-2000 is 50% of Nushagak River Black Point to Iowithla. Source: Howe et al. 1995, 1996, 2001a-d; Mills 1987-1994; and Walker et al. 2003.

Table 1.-Page 2 of 2.

[e] Includes Ekwok area, Iowithla River, Klutuk River, Koliganek area, New Stuyahok area, Portage Creek area, Kokwok area, Mulchatna River, and Nushagak watershed site unknown. Source: ADF&G Subsistence Division, Subsistence Database from Charles Utermohle, Program Coordinator, Subsistence Division, Region II, Anchorage, November 20, 2000. Data for 2000 provided by James Fall, Subsistence Division, Region II, Anchorage.

[f] 1986-1996 is 50% of Nushagak River System Sport Harvest, plus Mulchatna River System, Tikchik/Nuyakuk, and Koktuli River harvest reported in Howe et al. 1995, 1996, 2001b; Mills 1987-1994. 1997-2000 is 50% of Nushagak River Black Point to Iowithla, Nushagak upstream of Iowithla, Mulchatna River System, Tikchik/Nuyakuk and Koktuli River from Howe et al. 2001b-d; and Walker et al. 2003.

[g] 1986-1996, and 1998-99 estimates are sonar estimates minus subsistence and sport harvest above sonar.

[h] Source: Dunaway and Sonnichsen 2001.

1990, 1991, 1994, and 1997 (Dunaway et al. 1991; Dunaway and Bingham 1992; Dunaway and Fleischman 1995; Lipchak *Unpublished*; Minard et al. 1998). The 1986 and 1997 creel surveys were very brief, leaving the 1990, 1991, and 1994 surveys as the only intensive work done on the middle Mulchatna River sport fishery. Management of the Nushagak and Mulchatna rivers sport fishery is documented in the Division of Sport Fish area management reports for the Bristol Bay area (Dunaway et al. 2000; Dunaway and Sonnichsen 2001; Minard and Dunaway 1994, 1995; Minard et al. 1998).

Information on commercial and subsistence harvests and escapements for the Nushagak River drainage are collected annually by the ADF&G Commercial Fisheries Division (CFD) and published annually in their Regional Information Report series. Data on commercial harvests are obtained from fish tickets, and data on subsistence harvests are provided from permits.

Data on inriver returns of Chinook salmon are available from several sources. A sonar project operated by the CFD, approximately 2 miles below the village of Portage Creek, provides estimates of Chinook salmon passage. Aerial surveys of the Nushagak River drainage provide indices of Chinook salmon spawning abundance and distribution on selected spawning grounds, insight into effects of the management plan, and supplement other data used to forecast future Chinook salmon returns. Aerial surveys of selected Chinook salmon spawning areas in the Nushagak River were routinely conducted from 1967 through 1988 (Table 2). From 1989-1996, few aerial surveys were conducted. However, aerial surveys conducted in 1997 provided a valuable alternative to the sonar counts for spawning escapement information.

Choggiung Ltd. has an active onsite trespass permitting program over the length of the study area, staffed with up to five people and equipped with several boats. They have sporadically collected information on the Chinook salmon sport fishery on the Nushagak River, but this information is limited to Choggiung permitted users and has not been published.

Despite the variety of information available, many data needs can only be supplied by onsite work. For several seasons, onsite monitoring has been required to assess developments in the popular Nushagak/Mulchatna sport fishery. This monitoring includes inseason estimates of sport effort, catch, and harvest by geographic segments of the fishery, assessments of angler practices, and characteristics and biological data of sport harvested fish. The lower 20 miles of the river have become increasingly congested. New guide operators, as well as an increasing number of private anglers, are using the reaches near the outlet of the Mulchatna River, and reaches from the outlet of the Iowithla River to the area of the village of New Stuyahok. New angler activity is reported on the Nushagak River upstream of the village of Koliganek as well. At the same time, use of the Mulchatna River from the outlet of the Koktuli River to the outlet of the Stuyahok River seems to have dispersed or diminished.

The purpose of the 2000 onsite survey, a feasibility project that covered nearly 130 miles of river (Figure 2), was to document angler distribution in the Nushagak River Chinook salmon fishery. Data will be used to review current and proposed regulations and evaluate management tools. Data will also be used to design regulations that will accommodate growth of the sport fishery in compliance with the management plan. Results of the 2000 study will be used to refine the data collection process, to set objectives for future studies, and to evaluate the accuracy and precision of estimates in the future.

Table 2.-Historic aerial escapement index counts of Chinook salmon in selected streams in the Wood, Nushagak, and Mulchatna River drainages, 1967-2000.

	Wood R.	Nushakgak and Mulchatna drainages								
Year	Muklung River	Iowithla River	Kokwok River	Klutispak River	King Salmon River	Stuyahok River	Koktuli River	Nushagak River[a]	Mulchatna River[b]	Total
1967	350	200				2,500	3,300			6,000
1968	750 [c]	850		310	1,000	2,470	4,220	970	510	10,330
1969	520	580	90 [c]	90	670	1,220	1,600	910 [c]	680 [d]	5,840
1970	590	700	110 [c]	320	1,060	1,900	1,500	1,180 [c]	880 [d]	7,650
1971	280	390	80 [c]							470
1972	150	170		280	900	610	1,450	690 [c]	510 [d]	4,610
1973				380	1,470	1,220	950			4,020
1974	1,010 [c]	860	60	440	2,000	2,300	3,920	2,340	2,160	14,080
1975	660	1,040	270	670	2,900	2,530	4,080	2,320 [c]	1,710 [d]	15,520
1976	840 [c]	1,110	560	1,180	3,510	3,750	6,710	1,760	2,580	21,160
1977	940 [c]	840	310	650	1,420	2,700	4,630	820	1,980	13,350
1978	1,170 [c]	1,700	520	1,940	4,450	4,400	6,730	5,850	2,280	27,870
1979	950 [c]	1,350	170	1,040	2,150	3,570	6,260	2,880	1,730	19,150
1980	1,600	2,310 [d]	70	970	4,500	7,200	10,620	5,300 [c]	3,920 [d]	34,890
1981	2,260	2,630	70	1,650	2,950	5,980	9,960	4,960 [c]	3,670 [d]	31,870
1982	790	2,520	90	350	8,390	3,640	6,780	4,380 [c]	3,240 [d]	29,390
1983	1,830 [c]	2,430	350	2,090	5,990	2,910	8,060	6,330	4,260	32,420
1984	1,300 [c]	1,080	110	770	1,780	2,010	2,860	2,800	1,060	12,470
1985	1,250	1,610	60	1,950	4,460	2,690	4,940	3,420 [c]	2,390 [d]	21,520
1986	230	270		170	380	520	290	380 [c]	260 [d]	2,270
1987	160	140		340	570	280	440	390 [c]	270 [d]	2,430
1988	430	550		780	1,380	2,040	2,580	1,800	710	9,840
1989						190 [c]	240 [c]			430
1990	60 [e]	120		340	900	830	3,390	630	800	7,010
1995	210 [e]	170	75	630	3,150	660	2,230			6,915
1997	1,240 [f]	640		1,190	8,900	1,460	6,220	21,818	1,496	41,724
1998	150 [g]	[g]	150 [g]	2,620	5,510	550 [g]	720	8,390	180 [g]	18,120
1999	95	450	145	1,545	6,825	645	2,075	6,467		18,152
2000	[h]									
Mean	762	988	183	908	3,089	2,251	3,954	3,773	1,694	16,840

[a] Nushagak River from the outlet of the Nuyakuk River to outlet of King Salmon River (to Big Bend in 1997).

[b] Mulchatna River from outlet of Mosquito Creek to outlet of Koktuli River (to outlet of Stuyahok River in 1997).

[c] Minimal estimate - very poor survey conditions.

[d] These numbers are proportional estimates rather than aerial live counts; estimates are based on the mean proportion of fish counted in these areas during year in which aerial coverage was complete.

[e] No surveys were conducted from 1991 through 1994, or in 1996.

[f] Survey conditions in 1997 excellent, water very clear and very low.

[g] Surveys conducted 8/11/98, well past peak of spawning; Iowithla River not surveyed. Remaining surveys conducted 7/29/98, before peak of spawning.

[h] No surveys were conducted.

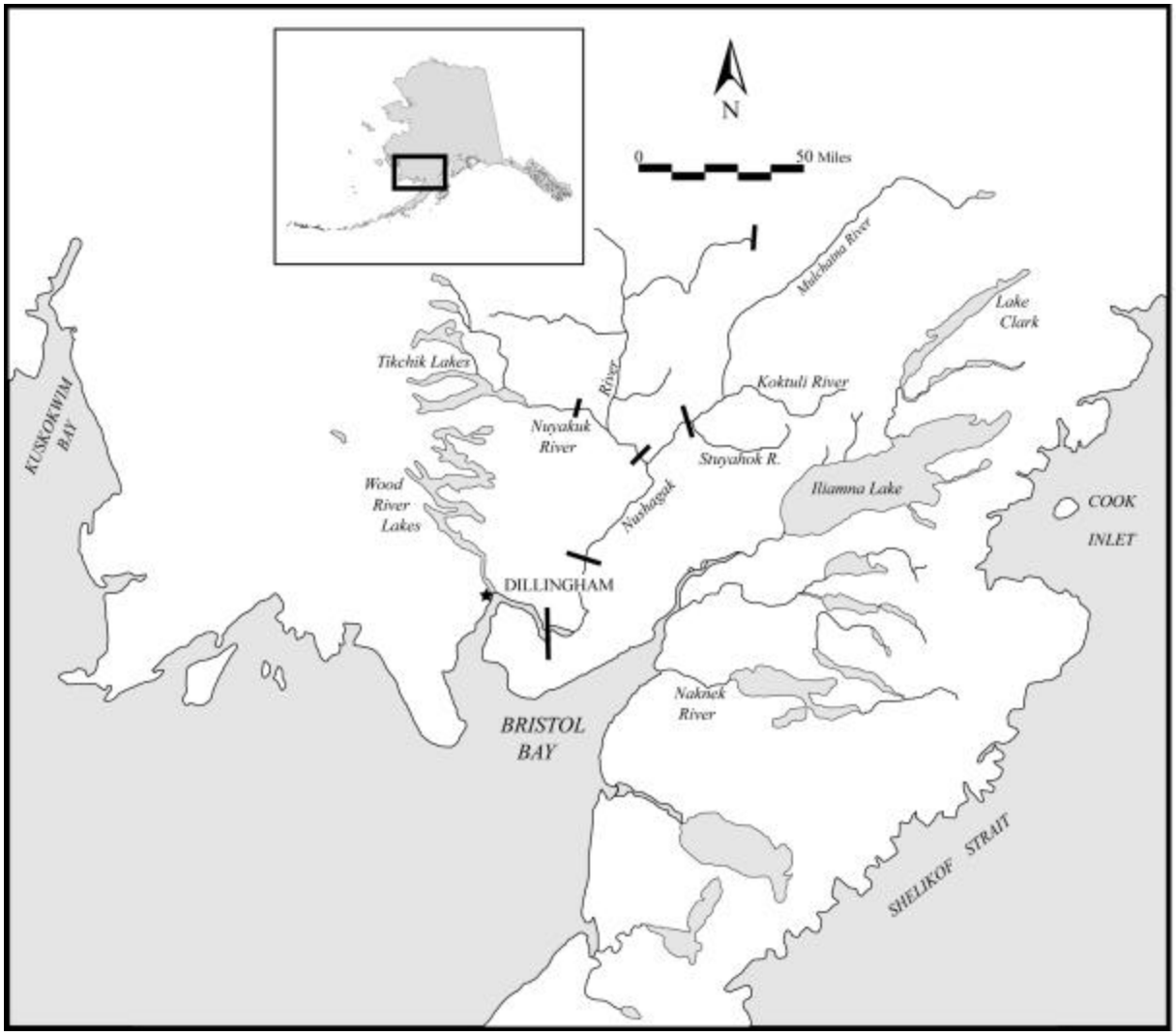

Figure 2.-Nushagak River Chinook salmon angler survey site.

OBJECTIVES

Objectives of the 2000 survey of the Chinook salmon sport fishery on the Nushagak River drainage were to:

1. Index angler effort in angler counts[1] in the lower and middle Nushagak River;
2. Index angler catch and harvest rates of Chinook salmon and composition of angler-days by gear and angler type in the lower Nushagak River;
3. Estimate the age, sex, length, and weight compositions of Chinook salmon in the sport harvest of the lower Nushagak River; and

[1] The objective in the operational plan for this project inadvertently stated "in angler-days."

4. Index the spawning escapement of Chinook salmon in selected tributaries of the Nushagak River.

An additional task was to index angler effort in the upper Nushagak River and lower reaches of the Nuyakuk River (upper study area).

METHODS

Three areas of the Nushagak River were surveyed in 2000. The lower study area was the mainstem Nushagak River from Black Point to the Lower Ekwok Land Boundary (LELB); the middle study area was from the LELB on the Nushagak River to the outlet of the Stuyahok River on the Mulchatna River; and the upper study area was the Nushagak River about ¼ mile upstream of the outlet of the Mulchatna River, and the Nuyakuk River (Figure 2). Each study area was further divided into three sublocations (Figures 3, 4, and 5). Sampling effort and data collected varied among the three study areas.

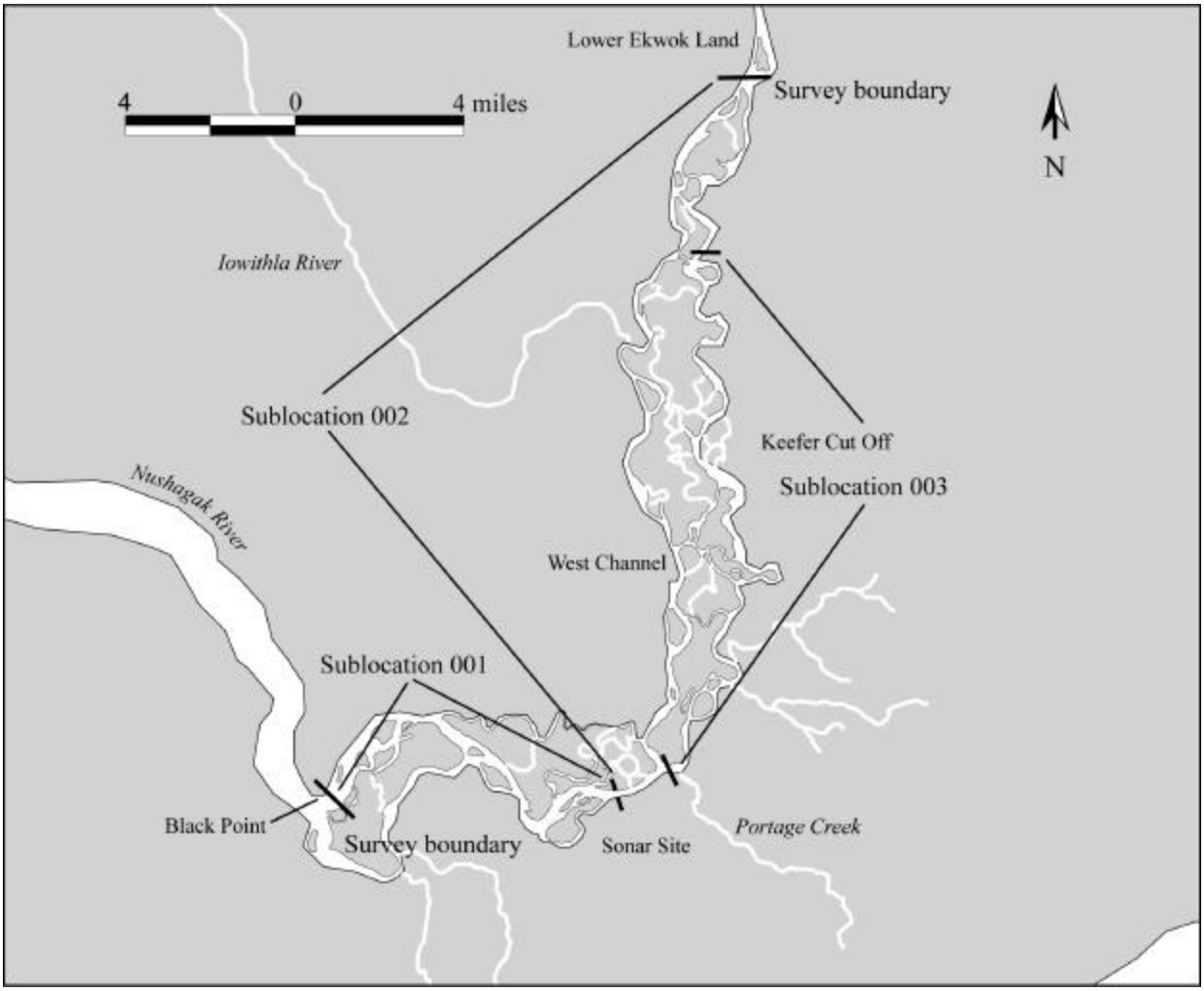

Figure 3.-Nushagak River lower study area sublocations.

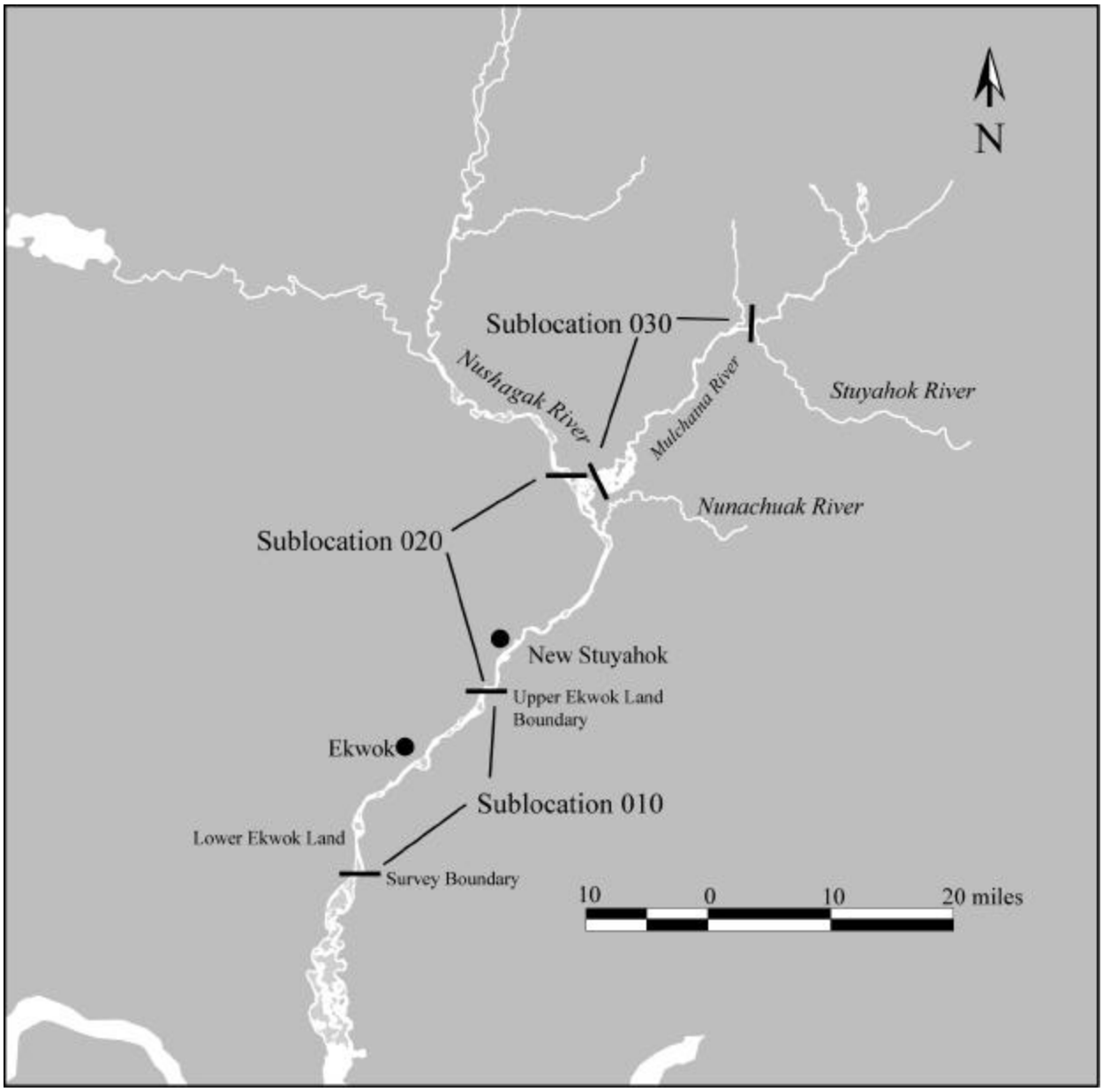

Figure 4.-Nushagak River middle study area sublocations.

This survey was conducted jointly by Choggiung Ltd. and the Division of Sport Fish. Choggiung Ltd. staff conducted angler counts in all three study areas and interviewed commercially permitted anglers in the lower study area. Two Sport Fish Division staff stationed in the lower study area trained and assisted Choggiung Ltd. staff with angler counts and interviews, and verified adherence to the study design by Choggiung Ltd. staff. Division staff also interviewed non-commercially/non-permitted anglers in the lower area, sampled harvested Chinook salmon in the lower area for biological data, and edited, summarized, and reported the data collected daily. Postseason, Division staff were responsible for analyzing data and writing reports.

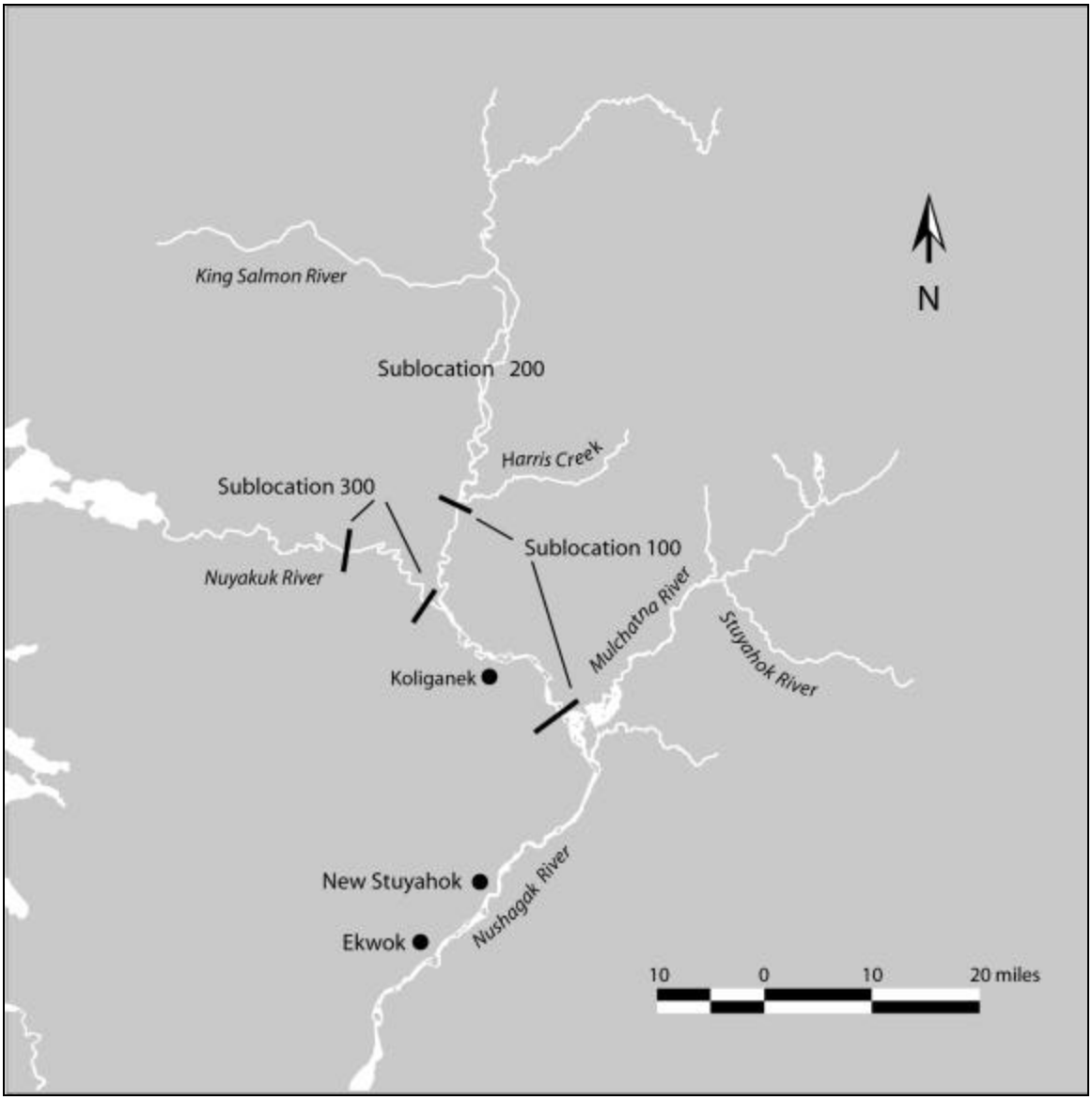

Figure 5.-Nushagak River upper study area sublocations.

This study was conducted during June and July 2000. The study design and sample schedule incorporated seasonal, weekly, and daily peaks in the Chinook salmon sport fishery based on Division and Choggiung Ltd. staffs' knowledge of the fishery. The survey was stratified by week and day type (weekend, weekday). All weekend days (Saturday and Sunday) and three of five weekdays chosen at random were sampled each week. Weekdays to sample were chosen separately for each area (i.e., different weekdays were sampled among areas in any week).

ANGLER COUNTS AND INTERVIEWS

In all three study areas, only one angler count was conducted during each sample day (Appendix A2). All counts began at the same time of day within each area. The time of day chosen to conduct the counts in each area was to represent the peak time of angling activity in that area based on anecdotal

evidence. Counts were not used to estimate angler effort because all possible count times were not surveyed. These counts provided an unbiased index of angler effort during the days and time sampled if the distribution of angler effort throughout the sampling day did not vary during the course of the survey. Conversely, if the within-day distribution of angler effort varied during the course of the survey (e.g., anglers shifted from morning to evening fishing), then the counts were not an unbiased index of angler effort. Angler counts were considered instantaneous and representative of angler effort when conducted. The starting time for the daily count was strictly observed.

Choggiung Ltd. staff counted all active anglers while driving a boat at a constant rate of speed through the study area. No stops were made except at sublocation boundaries to record start and finish times and angler counts. Active anglers were defined as individuals fishing and included those handling rods and tackle, repositioning a boat, landing a fish, repairing gear, or assisting another angler. An active angler did not include people solely operating boats or engaged in another activity not associated with angling (e.g., someone who put their gear away to eat lunch). For the middle and upper survey areas, children angling at village beaches were not counted because they typically do not target Chinook salmon and their catch and harvest is minimal. In the rare event of a missed count, the scheduled date and time, sublocation, and reason for the interruption were recorded on the data collection form.

Lower Study Area

Survey efforts were concentrated in the lower study area where most of the angling activity occurs, based on observations of ADF&G staff, and where Choggiung Ltd. concentrates most of their staff and equipment. The survey in this area was conducted from 15 June–15 July 2000. Every weekend day and 3 of 5 weekday days chosen at random were sampled each week. The lower study area was divided into three sublocations (Figure 3) as follows: (1) Black Point to the sonar site near Portage Creek (recorded as sublocation 001), (2) sonar site near Portage Creek to LELB using west channel (recorded as 002), and (3) Keefer cutoff just downstream of the confluence of Portage Creek to convergence of the channels using east channel (recorded as 003).

Angler counts began at 10:00 a.m. each sample day and took 1.5-2.5 hours to complete. Angler counts were recorded for each of the three sublocations. Two Choggiung Ltd. personnel conducted the counts. One individual began at Black Point and counted anglers while traveling upstream to the sonar site near Portage Creek. Another individual started counting at the sonar site and traveled up the west channel to LELB, then proceeded downstream and began counting again from the upper end of the Keefer cutoff downstream to the convergence ("Y") of east and west channels near Portage Creek. Both individuals began their counts at the same time (10:00 a.m.).

Due to logistics, angler interviews were conducted only in the lower study area where most fishing effort occurs. From 4:00 p.m. to 8:00 p.m. on each sample day, Choggiung Ltd. staff traveled throughout the lower study area via motorboat, stopped at every permitted commercial operation, and collected and recorded group interviews of commercially permitted anglers. Each daily group interview of commercially permitted anglers consisted of obtaining the total number of all anglers based with each operation who fished that day (including cooks, guides, pilots, etc. who fished); the total number of guided and unguided anglers; the total number of Chinook salmon kept and the total number released; and the number of anglers who used bait during that day (Appendix A3). These were complete-day

interviews. Number of anglers still fishing when the operation was sampled was also recorded; catch, harvest, and angler and gear type were not collected for incomplete-day anglers.

Because all commercially permitted anglers were interviewed (or at least accounted for by interviewing the operator contact for a group of anglers), a census of the effort (angler-days), catch, harvest, and gear and angler type of these anglers was obtained. It is assumed that nearly all anglers associated with permitted commercial operations completed their angler day by 4:00 p.m. to eat dinner; otherwise, if appreciable numbers of anglers continued to fish during, or began to fish after, the operation was sampled, the interview data may not be representative of this group of anglers.

Because these interview data are reflective of commercially permitted anglers only, data describing the characteristics of angler-days (catch, harvest, and angler and gear type) represents only this group of anglers. Estimates based on interviews from this angler group may not be representative of the whole fishery. Because Choggiung Ltd. owns most of the land above mean high water, commercially permitted anglers are believed to comprise the vast majority of all anglers on the lower Nushagak River so the estimates are probably descriptive of a large portion of the fishery.

In addition to interviews of commercially permitted anglers obtained by Choggiung Ltd. staff, Division staff interviewed non-commercially/non-permitted anglers. Locating and identifying this angler group required close daily coordination among Choggiung Ltd. and Division staff. Interviews resulted both from roving through the fishery and by stopping during the evening at camps that were not associated with commercial operations. Complete and incomplete-day anglers in this group were interviewed. Data were recorded for each angler, not a group interview. Staff recorded interview type (complete- or incomplete-day), number of Chinook salmon kept and the number released, angler type (guided or unguided), and gear type (use or no use of bait).

It is unknown what proportion of the fishery comprised the non-commercially/non-permitted angler group, but it is probably a much smaller group than the commercially permitted anglers interviewed by the Choggiung Ltd. staff. It is also unknown what proportion of this angler group was interviewed on a given sample day. However, it is expected that interviewing as many of the non-commercially/non-permitted anglers as possible each day provided some insight into their characteristics. Close daily coordination with the Choggiung Ltd. staff provided an indication of the numbers of this angler group in the area and thereby an approximation of the proportion interviewed.

Only anglers in the lower study area were interviewed to obtain data on catch and harvest rates and composition (proportion) of angler-days by gear (bait usage) and angler type (guided or unguided). Given the study design and time of day scheduled to conduct interviews, if different types of anglers and/or anglers with a different catch or harvest rate fish during hours of the day not surveyed, then estimates based on interviews are not representative of the whole fishery in the lower area.

Middle Study Area

The middle study area was limited to angler counts to index angler effort. The survey was conducted from 20 June–25 July 2000 in the middle study area. Every weekend day and 3 of 5 weekdays chosen at random were sampled each week. One Choggiung Ltd. employee conducted the counts beginning at 12:00 p.m. (noon) and took 2-3 hours to complete. Angler counts were recorded for each of three sublocations (Figure 4) as follows: (1) LELB to the upper Ekwok land boundary (UELB) at 59º 23’

25" N Lat. 157º 22'36" W Long. (sublocation 010); (2) UELB to the confluence of the Mulchatna River (sublocation 020); and (3) in the Mulchatna River from its confluence to the confluence of the Stuyahok River (sublocation 030). Counts began at the outlet of the Stuyahok River on the Mulchatna River, proceeded downstream into the Nushagak River, and downstream to LELB.

Upper Study Area

Work conducted in the upper study area was exploratory in 2000. Data were collected opportunistically because of the sparse knowledge of the fishery in this section of the Nushagak and Nuyakuk rivers. From 16 July–25 July, 2000, Choggiung Ltd. staff conducted only angler counts. Every weekend day and 2 of 5 weekdays chosen at random were sampled each week. Counts began at 12:00 p.m. (noon) each sample day and took 2-3 hours to complete.

Angler counts were recorded for each of three sublocations as follows: (1) in the Nushagak River from 0.25 mi upstream of the confluence of the Nushagak and Mulchatna rivers to the confluence of Harris Creek (sublocation 100), (2) in the Nushagak River upstream of the confluence of Harris Creek (sublocation 200), and (3) in the Nuyakuk River from its confluence upstream to the ADF&G cabin site (sublocation 300) (Figure 5).

Counts began on the Nushagak River about 0.25 mi upstream of the confluence with the Mulchatna River and proceeded up the Nushagak River to its confluence with Harris Creek and, when possible, continued further up the Nushagak River. Angler counts on the Nuyakuk River commenced at the confluence with the Nushagak River and extended upstream to the ADF&G cabin site.

BIOLOGICAL COMPOSITION OF THE SPORT HARVEST

Biological data from sport harvested Chinook salmon were collected in the lower study area only. Two Division staff roved the lower study area between 11:00 a.m. and 6:30 p.m. on sample days to collect age, sex, length, and weight data from all sport-harvested fish encountered. When possible, all Chinook salmon retained by an angler were sampled (i.e., no subsampling of the creel). Scales from at least 120 Chinook salmon were needed to attain the desired accuracy and precision, allowing for 15% unreadable scale samples (Thompson 1987). The sampling design was expected to yield a proportional sample of the harvest through the progression of the fishery (i.e., equal proportion of the harvest). The resultant data were treated as if collected from a simple random sample.

Harvested Chinook salmon were measured for length to the nearest millimeter from mid-eye to fork-of-tail, weighed to the nearest 0.25 kilograms, and sex determined based on external characteristics. In addition, three scales were removed from the preferred area[2] and mounted on an adhesive-coated card. Standard age determination procedures were used (Jearld Jr. 1983). The European system of age designation was used, where the number of freshwater winter annuli precedes the decimal and the number of marine winter annuli follows. Total age from the brood year is the sum of the two numerals plus one.

[2] The left side of the fish approximately two rows above the lateral line and on a diagonal line downward from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Welander 1940).

AERIAL ESCAPEMENT COUNTS

Aerial index counts were not conducted during 2000 due to poor weather conditions and personnel and aircraft shortages.

DATA ANALYSIS

As noted above, the single angler count conducted each day represents an index of angler effort. Daily counts by study area and sublocation were summarized. Interview data for commercially permitted anglers were summarized separately from data for non-commercially/non-permitted anglers.

Catch and Harvest Rates

Weekly estimates of catch per unit of effort (CPUE) were calculated as described below. Unit of effort was an angler-day. The first step involved calculating the CPUE of each day sampled:

$$\text{cpue}_{hi} = \frac{c_{hi}}{e_{hi}}, \tag{1}$$

where c_{hi} equals the number of fish caught (both kept and released) on the i^{th} day during the h^{th} week of the survey, and e_{hi} is the number of complete-day anglers who fished on the i^{th} day.

Then the weekly mean estimate of CPUE is simply:

$$\overline{\text{cpue}}_h = \frac{\sum_{i=1}^{m_h} \text{cpue}_{hi}}{m_h}, \tag{2}$$

where m_h equals the number of days sampled (= 5) in the lower study area during each week of the survey.

Variance of mean CPUE was estimated by:

$$\hat{V}\left[\overline{\text{cpue}}_h\right] = \frac{\sum_{i=1}^{m_h} \left(\text{cpue}_{hi} - \overline{\text{cpue}}_h\right)^2}{m_h\left(m_h - 1\right)}. \tag{3}$$

The standard error (SE) was estimated as the square root of the variance estimate. Harvest per unit of effort (HPUE) was estimated similarly, replacing harvest (only fish kept) for catch.

Due to the low number of completed-trip interviews, CPUE and HPUE were not estimated for non-commercially/non-permitted anglers.

Angler Compositions

The proportion of angler-days by the categories of terminal gear type (or with commercially-permitted anglers, bait use) and angler type (guided or unguided) was estimated as:

$$\hat{p}_z = \frac{m_z}{m}, \tag{4}$$

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

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

Assumptions

The assumptions necessary for unbiased point and variance estimates obtained by the above procedures are:

1. Interviewed anglers accurately reported the number of Chinook salmon kept and released;
2. Choggiung Ltd. and Division staff accurately classified anglers and the interviewed anglers accurately reported their trip type (guided, unguided) and terminal gear type (use of bait) during their fishing day;
3. Catch rate and duration of fishing trip were independent (necessary due to roving interviews collected by Division staff and for completed-day interviews to be representative of the fishery if appreciable numbers of incomplete-day anglers appeared during the survey - anglers with longer fishing trips may have had a different probability of being intercepted for an interview);
4. The distribution of angler effort within the angling day did not vary substantially during the course of the survey (necessary for CPUE to be an unbiased index of fish abundance, and for the single angler count to be an unbiased index of angler effort); and
5. Catchability of Chinook salmon did not vary substantially during the course of the survey (necessary for CPUE to be an unbiased index of fish abundance).

There are no direct ways of evaluating or testing any of the assumptions. For assumptions 1 and 2, anglers were expected to have a good recollection of the total number of fish kept and released, and to have accurately reported details of their fishing day. In addition, project staff were expected to accurately record interview data. Assumptions 3, 4, and 5 should be valid if interviews collected at permitted commercial operations resulted in a census of completed-day commercially-permitted anglers and commercially-permitted anglers comprised the vast majority of effort in the fishery.

Biological Composition of the Sport Harvest

The proportion of harvested Chinook salmon of category (age, sex, length, or weight class) u was estimated as:

$$\hat{p}_u = \frac{n_u}{n}, \tag{5}$$

where n_u equals the number of sampled Chinook salmon in category u; and n equals the total number of Chinook salmon sampled.

Variance of each proportion was estimated without the finite population correction factor, because we do not have harvest estimates:

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

Mean length- and weight-at-age of harvested Chinook salmon were estimated following standard procedures (Sokal and Rohlf 1981). The standard error was estimated as the square root of the variance estimate.

Copies of all data files and analysis programs are archived with ADF&G Sport Fish Division, Research and Technical Services, in Anchorage (Appendix A4).

RESULTS

ANGLER COUNTS

A total of 4,648 anglers was counted in the lower study area in 2000 (Table 3). Counts ranged from a peak of 404 on 25 June to a low of 38 on 15 June. Effort was distributed relatively evenly between sublocations with a total of 1,572 anglers counted in sublocation 001, 1,438 anglers counted in sublocation 002, and 1,638 anglers counted in sublocation 003 (Table 3). In the middle study area a total of 1,080 anglers were counted with counts ranging from a maximum of 94 on 2 July to a low of 3 on 20 June (Table 4). In the upper study area, a total of 64 anglers were counted with counts ranging from 48 on 22 July to zero on 18 July (Table 5).

Table 3.-Angler counts by date and sublocation during the survey on the lower Nushagak River, 15 June–15 July 2000.

	Sublocation			
Date	001	002	003	Total
15-Jun	5	9	24	38
16-Jun	21	17	21	59
17-Jun	28	24	33	85
18-Jun	37	23	45	105
20-Jun	42	47	101	190
21-Jun	98	75	71	244
23-Jun	87	87	124	298
24-Jun	126	55	94	275
25-Jun	208	60	136	404
28-Jun	99	175	89	363
29-Jun	103	76	78	257
30-Jun	93	57	103	253
1-Jul	98	61	146	305
2-Jul	115	82	103	300
3-Jul	105	65	111	281
5-Jul	41	117	100	258
7-Jul	35	79	68	182
8-Jul	50	101	80	231
9-Jul	51	88	26	165
11-Jul	42	44	24	110
12-Jul	36	48	22	106
13-Jul	40	36	13	89
15-Jul	12	12	26	50
Total	1,572	1,438	1,638	4,648

Table 4.-Angler counts by date and sublocation during the survey on the middle Nushagak River, 15 June–15 July 2000.

Date	Sublocation 010	020	030	Total
20-Jun	0	3	0	3
21-Jun	11	6	0	17
22-Jun	21	6	0	27
24-Jun	7	27		34
25-Jun	12	19		31
26-Jun	11	19		30
27-Jun	27	17		44
28-Jun	19	20		39
30-Jun	44	20	13	77
1-Jul	43	30	15	88
2-Jul	54	14	26	94
4-Jul	44	20	27	91
6-Jul	29	20	20	69
7-Jul	26	16	13	55
8-Jul	23	17	15	55
9-Jul	32	32	13	77
11-Jul	6	18	6	30
12-Jul	3	8	10	21
13-Jul	3	8	10	21
14-Jul	8	2	8	18
16-Jul	15	16	11	42
18-Jul	15	0	11	26
19-Jul	5	11	6	22
20-Jul	8	0	9	17
22-Jul	10	10	0	20
23-Jul	10	4	4	18
24-Jul				
25-Jul	9	2	3	14
Total	495	365	220	1,080

ANGLER INTERVIEWS

In 2000, 4,208 commercially permitted anglers were interviewed (Table 6). Reported harvest was 2,460 chinook salmon, and 10,788 (81% of total) chinook salmon were released. Interviews were obtained for 202 non-commercially/non-permitted anglers, who harvested 34 (18%) and released 156 (82%) chinook salmon.

Weekly estimates of CPUE for commercially permitted anglers ranged from 1.13 fish per angler-day (SE = 0) for 15-18 June to 4.42 (SE = 0.37) for 26 June-2 July. Overall CPUE was 2.82 fish per angler-day (SE = 0.56, Table 6). Weekly estimates of HPUE for commercially permitted anglers ranged from 0.19 per angler-day (SE = 0) for 15-18 June to 0.70 (SE = 0.04) for 26 June-2 July; overall HPUE was 0.52 (SE = 0.04; Table 6).

Table 5.-Angler counts by date and sublocation during the survey on the upper Nushagak River, 16 June–25 July 2000.

	Sublocation Count			
Date	100	200	300	Total
16-Jul	4	0	0	4
18-Jul	0		0	0
21-Jul				
22-Jul	33	15	0	48
23-Jul	1	0	0	1
24-Jul	0	2	4	6
25-Jul	3	0	2	5
Total	41	17	6	64

Table 6.-Catch and harvest per unit effort for the Chinook salmon sport fishery in the lower Nushagak River, 15 June through 15 July 2000.

Week	Sample Size	CPUE[a]	SE	HPUE[b]	SE
Commercially Permitted Anglers					
1 (15-18 June)	351	1.13	0[c]	0.19	0[c]
2 (19-25 June)	1,304	3.23	0.98	0.57	0.10
3 (26 June -02 July)	1,327	4.42	0.37	0.70	0.04
4 (03-09 July)	924	2.47	0.30	0.48	0.04
5 (10-15 July)	302	1.15	0.17	0.32	0.03
Total (15 June -15 July)	4,208	2.82	0.56	0.52	0.04
Non-Commercially/Non-Permitted Anglers[d]					
15 June -15 July	14	0.75	0.22	0.25	0.12

[a] Number of fish caught per angler-day of effort.

[b] Number of fish harvested per angler-day effort.

[c] Standard error is zero due to only one day being sampled during this week.

[d] Weekly estimates were not calculated due to low number of complete-trip interviews.

Of 4,208 commercially permitted anglers interviewed, 88% were guided and 62% used bait (Table 7). Of 202 non-commercially/non-permitted anglers interviewed, all were unguided, 49% were Alaska residents, 25% were local Alaska residents, 97% used spinning gear, and 48% used bait (Table 7).

BIOLOGICAL COMPOSITION

Biological data were collected from 392 harvested chinook salmon. The majority of the harvest was male (56%; SE = 2.7; Table 8). The predominant age groups among all fish sampled with readable scales were age 1.4 (34.7%, SE = 2.6) and age 1.5 (33.8%, SE = 2.5). Overall average mid-eye to fork length was 796 mm (SE = 7) and overall average weight was 9.4 kg (SE = 3.5). The longest fish sampled was 1,035 mm in length, weighed 18.25 kg and was caught on 2 July.

AERIAL ESCAPEMENT COUNTS

Aerial index counts were not conducted in 2000 due to poor weather and personnel and aircraft shortages. Foot surveys were not conducted. Therefore, there is no index for 2000.

DISCUSSION

The study design for the 2000 survey of the Nushagak Chinook salmon sport fishery was different from previous studies (Dunaway and Bingham 1992; Dunaway and Fleischman 1995; Minard and Brookover 1988) in several ways. Therefore most statistics are not comparable between years.

Angler counts in the lower study area during 2000 were nearly evenly distributed between sublocations (Table 3). Counts in this study area gradually increased to a peak on 25 June and declined to very low levels of effort by the end of the project (15 July). In the middle study area, counts also gradually increased to a peak on 2 July and slowly tapered off through 25 July. The greatest angling effort in this area occurred in sublocation 010 between the lower and upper Ekwok Land boundaries (Table 4). Effort at the confluence of the Mulchatna and Stuyahok rivers in sublocation 030 was low and appears to have declined from previous years. In the upper study area, no pattern was detected, and overall effort on days that were counted was very low with the exception of 22 July (Table 5). As expected, as anglers followed salmon upstream later in the season, peaks in effort were correlated with counts conducted further upstream.

Demographic data for 2000 indicate that most (88%) commercially permitted anglers were guided and that nearly all non-commercially/non-permitted anglers were unguided (Table 7). Bait was used by a majority of anglers during the lower Nushagak Chinook salmon fishery, indicating that restriction of bait may be an effective management tool for conservation of Chinook salmon during low run years.

Because CPUE and HPUE estimates were calculated in angler-days for the 2000 study, they are not comparable to estimates from previous years which were estimated in angler-hours. Daily CPUE estimates were highly variable during 2000 and clearly coincided with Chinook salmon passage estimates at the CFD sonar site (Figure 6). Weekly HPUE also coincided with sonar passage estimates, although to a lesser degree. The stability of the HPUE estimates was likely a function of the seasonal bag limit of 4 Chinook salmon in the Nushagak drainage. Regardless of catch rates, over the course of a multiple day angling trip, anglers were likely to catch and harvest their seasonal bag limit.

Table 7.-Number and percent of angler trips by angler and gear type during the Chinook salmon sport fishery on the lower Nushagak River, 15 June through 15 July 2000.

Characteristic	Angler Trips		Percent	
	Commercially Permitted Anglers	Non-commercially/ Non-permitted Anglers	Commercially Permitted Anglers	Non-commercially/ Non-permitted Anglers
ANGLER TYPE[a]				
Guided	3,716	0	88	0
Unguided	492	202	12	100
RESIDENCY[b]				
U.S. Resident		196		97
Alaskan Residents		99		49
Local Alaskan Residents[c]		51		25
Nonlocal Alaskan Residents[d]		48		24
Non-Alaskan Residents		97		48
Non-U.S. Resident		6		3
SEX[b]				
Male		171		85
Female		31		15
TACKLE TYPE				
Spin[b]		195		97
Fly[b]		7		3
Spin and Fly[b]		0		0
Bait[a]	2,574	97	62	48
TYPE OF INTERVIEW[a]				
Complete Trip	4,208	14	100	7
Incomplete Trip	0	188	0	93
Total Angler Trips	4,410			

[a] Includes all interviews.

[b] Includes only interviews of anglers not associated with Choggiung Ltd. permitted commercial camps.

[c] Alaskan resident living in Dillingham, Aleknagik, Portage Creek, Ekwok, New Stuyahok, or Koliganek.

[d] All other Alaskan residents.

Table 8.-Mean lengths (millimeters) and weights (kilograms) of Chinook salmon, by sex and age group, from samples collected from the lower Nushagak sport harvest, 15 June through 15 July 2000.

		Age Group							
Characteristic	Unknown	1.1	1.2	1.3	1.4	1.5	1.6	1.7	Total
Females									
Percent		0.0	0.0	2.0	25.6	20.2	5.2	0.3	43.4
SE				0.8	2.0	2.2	1.2	0.3	2.7
Sample size	21	0	0	7	54	70	18	1	150
Mean length	860			735	856	867	858	901	856
SE	14			21	8	6	8		5
Sample size	21	0	0	7	54	70	18	1	150
Mean weight	11			7	11	11	11	11	11
SE	0			1	0	0	0		0
Sample size	21	0	0	7	54	70	18	1	150
Males									
Percent		0.3	6.4	12.4	18.8	13.6	4.9	0.0	56.0
SE		0.3	1.3	1.8	2.1	1.8	1.2		2.7
Sample size	25	1	22	43	65	47	17	0	195
Mean length	774	337	544	630	775	877	843		748
SE	27		6	15	15	14	18		10
Sample size	25	1	22	43	65	47	17		220
Mean weight	8	1	3	4	10	13	10		9
SE	1		0	0	1	2	1		1
Sample size	25	1	22	43	65	47	17		220
All Samples									
Percent		0.3	6.4	14.5	34.7	33.8	10.1	0.3	100
SE		0.3	1.3	1.9	2.6	2.5	1.6	0.3	0
Sample size[a]	46	1	22	50	120	117	35	1	346
Mean length	813	337	544	645	812	871	851	901	796
SE	17		6	14	9	7	10		7
Mean weight	9	1	3	5	10	12	10	11	9
SE	1		0	0	1	1	0		0

[a] Includes one fish of unknown sex.

The age composition of Chinook salmon harvested in the sport fishery appears to have shifted toward older fish since the 1991 and 1994 surveys. Age-1.4 Chinook salmon comprised 38%, 53%, and 35% of the sampled sport harvests in 1991, 1994, and 2000, respectively. However, age-1.5 fish comprised 34% of the of the sport harvest in 2000, compared to 4% in 1991 and 1994.

This survey was most useful in characterizing the utilization of the lower Nushagak River Chinook salmon fishery by non-resident guided anglers who either used river-based camps or were flown in from another lodge for the day. With the assistance of Choggiung Ltd. staff and cooperation of the anglers, it was relatively easy to obtain information from nearly all of these anglers. Several local Alaskan

residents were also interviewed, most likely due to the river's close proximity to Dillingham and several smaller villages.

We recommend using similar methods and assistance of Choggiung Ltd. in future surveys of the Nushagak River Chinook salmon fishery on a regular basis. This will provide information that is comparable among years and thus more useful for monitoring changes in the fishery, which is effective for managing this important sport fishery. With greater understanding of the fishery and its participants, the department will be more prepared to face management challenges in the future.

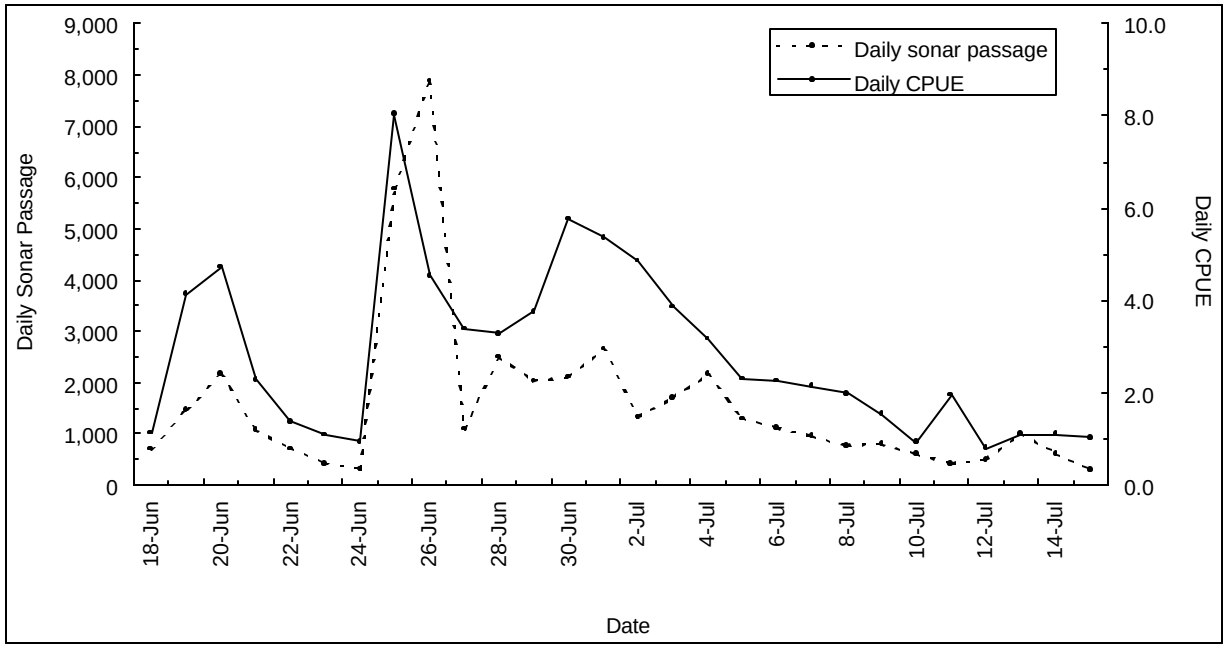

Figure 6.-Daily Chinook salmon catch and sonar passage estimates from the lower Nushagak River, 15 June–15 July 2000.

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APPENDIX A. SUPPORTING INFORMATION

Appendix A1.-Nushagak-Mulchatna chinook salmon management plan.

5 AAC 06.361. NUSHAGAK-MULCHATNA CHINOOK SALMON MANAGEMENT PLAN.

(a) The purpose of this management plan is to ensure biological spawning escapement requirements of chinook salmon into the Nushagak-Mulchatna river systems. It is the intent of the Alaska Board of Fisheries (board) that Nushagak-Mulchatna chinook salmon be harvested in the fisheries that have historically harvested them. This management plan provides guidelines to the department in an effort to preclude allocation conflicts between the various users of this resource. The department shall manage Nushagak-Mulchatna chinook salmon stocks in a conservative manner consistent with sustained yield principles and the subsistence priority.

(b) The department shall manage the commercial fishery in the Nushagak District as follows:

(1) to achieve an inriver goal of 75,000 chinook salmon present in the Nushagak River upstream from the department sonar counter; the inriver goal provides for

(A) a biological escapement requirement of 65,000 fish;

(B) reasonable opportunity for subsistence harvest of chinook salmon; and

(C) a chinook salmon sport fishery guideline harvest level of 5,000 fish;

(2) in order to maintain a natural representation of age classes in the escapement, the department shall attempt to schedule commercial openings to provide pulses of fish into the river that have not been subject to harvest by commercial gear.

(c) If the total inriver chinook salmon return in the Nushagak River is projected to exceed 75,000 fish, the guideline harvest level described in (b)(1)(C) of this section does not apply.

(d) If the spawning escapement of chinook salmon in the Nushagak River is projected to be more than 40,000 and the projected inriver return is less than 75,000 fish, the commissioner

(1) shall close, by emergency order, the directed chinook salmon commercial fishery in the Nushagak District; during a closure under this paragraph, the use of a commercial gillnet with webbing larger than five and one-half inches in another commercial salmon fishery is prohibited; and

(2) if the projected inriver return of chinook salmon in the Nushagak River is less than 55,000 fish, and to ensure that projected spawning escapement does not fall below 40,000 fish, shall establish, by emergency order, fishing periods to restrict the chinook salmon sport fishery in the Nushagak River during which any, or a combination, of the following restrictions may be applied:

(A) reduction of bag and possession limits;

(i) from two to one fish; and

(ii) if necessary, from one fish to non-retention of chinook salmon; if a non-retention fishery for chinook salmon is established under this paragraph, the use of bait will be prohibited [for all species of fish] until the end of the chinook salmon season;

(B) a seasonal limit of up to four fish;

(C) prohibition of the use of bait;

(D) reductions in the time or area for fishing;

(E) a closure of the chinook salmon sport fishery.

(e) If the spawning escapement of chinook salmon in the Nushagak River is projected to be less than 40,000 fish, the commissioner

(1) shall close, by emergency order, the sockeye salmon commercial fishery in the Nushagak District until the projected sockeye salmon escapement into the Wood River exceeds 100,000 fish;

(2) shall close, by emergency order, the sport fishery in the Nushagak River to the taking of chinook salmon; and

(3) shall establish, by emergency order, fishing periods during which the time or area is reduced for the inriver chinook salmon subsistence fishery in the Nushagak River.

Appendix A2.-Angler count schedule for lower, middle, and upper Nushagak River study areas, 2000.

Date	Day	Lower	Middle	Upper
12-Jun	Mon			
13-Jun	Tues			
14-Jun	Wed			
15-Jun	Thur	10:00 AM		
16-Jun	Fri	10:00 AM		
17-Jun	Sat	10:00 AM		
18-Jun	Sun	10:00 AM		
19-Jun	Mon		Noon	
20-Jun	Tues	10:00 AM		
21-Jun	Wed	10:00 AM	Noon	
22-Jun	Thur		Noon	
23-Jun	Fri	10:00 AM		
24-Jun	Sat	10:00 AM	Noon	
25-Jun	Sun	10:00 AM	Noon	
26-Jun	Mon		Noon	
27-Jun	Tues			
28-Jun	Wed	10:00 AM	Noon	
29-Jun	Thur	10:00 AM		
30-Jun	Fri	10:00 AM	Noon	
1-Jul	Sat	10:00 AM	Noon	
2-Jul	Sun	10:00 AM	Noon	
3-Jul	Mon	10:00 AM		
4-Jul	Tues		Noon	
5-Jul	Wed	10:00 AM		
6-Jul	Thur		Noon	
7-Jul	Fri	10:00 AM	Noon	
8-Jul	Sat	10:00 AM	Noon	
9-Jul	Sun	10:00 AM	Noon	
10-Jul	Mon			
11-Jul	Tues	10:00 AM	Noon	
12-Jul	Wed	10:00 AM	Noon	
13-Jul	Thur	10:00 AM		
14-Jul	Fri		Noon	
15-Jul	Sat	10:00 AM end		
16-Jul	Sun		Noon	Noon
17-Jul	Mon			
18-Jul	Tues		Noon	Noon
19-Jul	Wed		Noon	
20-Jul	Thur.		Noon	
21-Jul	Fri			Noon
22-Jul	Sat		Noon	Noon
23-Jul	Sun		Noon	Noon
24-Jul	Mon		Noon	Noon
25-Jul	Tues		Noon	Noon
			End	End

Appendix A3.-Interview cards provided to commercial operations with Choggiung Ltd. permits, 2000.

Lower Area Camp daily tally

Camp: _____ **DATE:** _____

Number Guided Anglers [1]	Un-guided Anglers	Number who used bait	Kings Kept	Kings Released	Total Kings Caught	Other notes.
totals below						

[1] Guided anglers include all camp employees and guides who fished for any time during a day.

Appendix A4.-Data files and computer programs used to produce this report.

Data Files

T-000300I012000.dta	Lower Nushagak River angler interview data from 15 June through 15 July 2000.
T-000300C012000.dta	Lower survey area angler count data from 15 June through 15 July 2000.
T-000300C022000.dta	Middle survey area angler count data from 15 June through 15 July 2000.
T-000300C032000.dta	Upper survey area angler count data from 15 June through 15 July 2000.
T-000300B012000.dta	Nushagak River Chinook salmon AWL data from 15 June through 15 July 2000.

Analysis Programs

BBX.SAS

Microsoft Excel