

**Fishery Data Series No. 12-67**

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**Monitoring the Chinook Salmon Sport Fishery on the  
Nushagak River Drainage, Alaska, 2007**

by

**Jason E. Dye**

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November 2012

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.

<b>Weights and measures (metric)</b>		<b>General</b>		<b>Mathematics, statistics</b>	
centimeter	cm	Alaska Administrative Code	AAC	<i>all standard mathematical signs, symbols and abbreviations</i>	
deciliter	dL	all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.	alternate hypothesis	$H_A$
gram	g	all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.	base of natural logarithm	$e$
hectare	ha	at	@	catch per unit effort	CPUE
kilogram	kg	compass directions:		coefficient of variation	CV
kilometer	km	east	E	common test statistics etc.)	(F, t, $\chi^2$ ,
liter	L	north	N	confidence interval	CI
meter	m	south	S	correlation coefficient (multiple)	R
milliliter	mL	west	W	correlation coefficient (simple)	r
millimeter	mm	copyright	©	covariance	cov
		corporate suffixes:		degree (angular)	°
		Company	Co.	degrees of freedom	df
<b>Weights and measures (English)</b>		Corporation	Corp.	expected value	$E$
cubic feet per second	ft <sup>3</sup> /s	Incorporated	Inc.	greater than	>
foot	ft	Limited	Ltd.	greater than or equal to	≥
gallon	gal	District of Columbia	D.C.	harvest per unit effort	HPUE
inch	in	et alii (and others)	et al.	less than	<
mile	mi	et cetera (and so forth)	etc.	less than or equal to	≤
nautical mile	nmi	exempli gratia		logarithm (natural)	ln
ounce	oz	(for example)	e.g.	logarithm (base 10)	log
pound	lb	Federal Information Code	FIC	logarithm (specify base)	log <sub>2</sub> , etc.
quart	qt	id est (that is)	i.e.	minute (angular)	'
yard	yd	latitude or longitude	lat. or long.	not significant	NS
		monetary symbols		null hypothesis	$H_0$
		(U.S.)	\$, ¢	percent	%
		months (tables and figures): first three letters	Jan,...,Dec	probability	P
<b>Time and temperature</b>		registered trademark	®	probability of a type I error (rejection of the null hypothesis when true)	$\alpha$
day	d	trademark	™	probability of a type II error (acceptance of the null hypothesis when false)	$\beta$
degrees Celsius	°C	United States (adjective)	U.S.	second (angular)	"
degrees Fahrenheit	°F	United States of America (noun)	USA	standard deviation	SD
degrees kelvin	K	U.S.C.	U.S.C.	standard error	SE
hour	h	U.S. state	U.S. state	variance	
minute	min			population	Var
second	s			sample	var
<b>Physics and chemistry</b>					
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				

***FISHERY DATA SERIES NO. 12-67***

**MONITORING THE CHINOOK SALMON SPORT FISHERY ON THE  
NUSHAGAK RIVER DRAINAGE, ALASKA, 2007**

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## ABSTRACT

A survey of the sport fishery for Chinook salmon on the lower Nushagak River was conducted from 15 June through 10 July 2007. Unguided anglers were interviewed for information on catch, harvest, effort, and demographic characteristics. Age, sex, length, and weight data were collected separately from Chinook salmon harvested by guided and unguided anglers. During the survey, 123 unguided anglers were interviewed. Catch per unit effort and harvest per unit effort averaged 2.27 and 0.42 Chinook salmon per angler-day respectively. Most anglers were residents of Alaska (59%). A majority of anglers used bait (57%). The average length of Chinook salmon sampled from guided anglers was 734 mm (SE 13.6) and the average weight was 8.1 kg (SE 0.34). The average length of Chinook salmon sampled from unguided anglers was 776 mm (SE 14.7) and the average weight was 8.1 kg (SE 0.33). Chinook salmon harvested by guided anglers were predominantly ocean age 1.3 (36%) and 1.4 (36%). Chinook salmon harvested by unguided anglers were also predominantly ocean age 1.3 (39%) and 1.4 (40%).

Keywords: Chinook salmon, *Oncorhynchus tshawytscha*, Nushagak River, catch rates, demographic characteristics, biological composition.

## INTRODUCTION

The Bristol Bay Management Area supports several important Chinook salmon (*Oncorhynchus tshawytscha*) sport fisheries, notably in the Alagnak, Naknek, Nushagak, and Togiak rivers (Figure 1). The Nushagak River hosts the largest Chinook salmon fisheries in the region. Major Alaskan sport fisheries are monitored postseason by the Alaska Department of Fish and Game (ADF&G) annual statewide harvest survey (Mills 1979-1994; Howe et al. 1995-1996, 2001a-d; Walker et al. 2003; Jennings et al. 2004, 2006a-b, 2007, 2009a-b, 2010) and by the ADF&G statewide freshwater guided sport fishing reporting program (Sigurdsson and Powers 2009). However, management of the fishery as prescribed in regulation can only be accomplished by on-site data collection providing timely estimates of sport fishery effort, catch, and harvest by geographic segments, assessments of angler practices and angler demographic characteristics, and biological data from fish harvested by the sport fishery.

The Nushagak River sport fishery is currently managed in accordance with the *Nushagak-Mulchatna King Salmon Management Plan* (Alaska Administrative Code 5AAC 06.361, Appendix A1). During years when inriver projections are less than 75,000 Chinook salmon, ADF&G is expected to manage the sport harvest such that it does not exceed 5,000 fish annually. The plan outlines a run projection level 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 its ability to equal or exceed the guideline harvest level in the plan with the previous 5-year harvest levels ranging from 3,693 fish in 2002 to 7,473 fish in 2006 (Table 1; Jennings et al. 2006a, 2009). To comply with the plan and maintain the sport fishery within its harvest allocation, ADF&G has issued emergency order bag limit reductions based on preseason and inseason run strength projections during the 1996, 1997, and 1999 seasons (Dunaway et al. 2000; unpublished data from Dan Dunaway, Area Management Biologist, 30 June 30 1999 Emergency Order, Dillingham).

The sport fishery regulations stipulate, in part, an annual bag limit of four Chinook salmon 20 inches or longer and a daily bag limit of two Chinook salmon 20 inches or longer, only one of which may be longer than 28 inches total length in the Nushagak River drainage (5ACC 67.022[g]). For Chinook salmon under 20 inches in length, the daily bag limit is 5 and there is no annual limit. The open season for Chinook salmon is 1 May through 31 July in the Nushagak River downstream from the confluence with the Iowithla River (5AAC 67.010 and 5ACC 67.022). Upstream of the confluence with the Iowithla River, and including the Iowithla River,

the open season is 1 May through 24 July (5ACC 67.022). Below-average run performances in 1999 and 2000 raised new demands to modify the management plan in order to provide greater conservation in years of low returns. In January of 2001, the Alaska Board of Fisheries (BOF) amended the plan to specifically allow ADF&G to limit the fishery to catch-and-release only when run strength is below desired levels. In addition, the plan stipulates that when the fishery is restricted to catch-and-release or is closed for conservation, the use of bait must be prohibited in the fishery. In December of 2003, BOF adopted a regulation allowing a daily harvest of five Chinook salmon less than 20 inches in length; these fish do not count toward the annual limit nor toward the management plan's guideline harvest level of 5,000 Chinook salmon.

The Nushagak/Mulchatna king salmon sport fishery has been rapidly evolving; therefore, regular on-site monitoring is required to assess the latest developments in this popular fishery. Data collected from on-site surveys are used to design regulations that will accommodate growth of the sport fishery and maintain angling opportunity. Additionally, data collected during this survey will be used to review the effectiveness of current regulations and to assess compliance with the management plan.

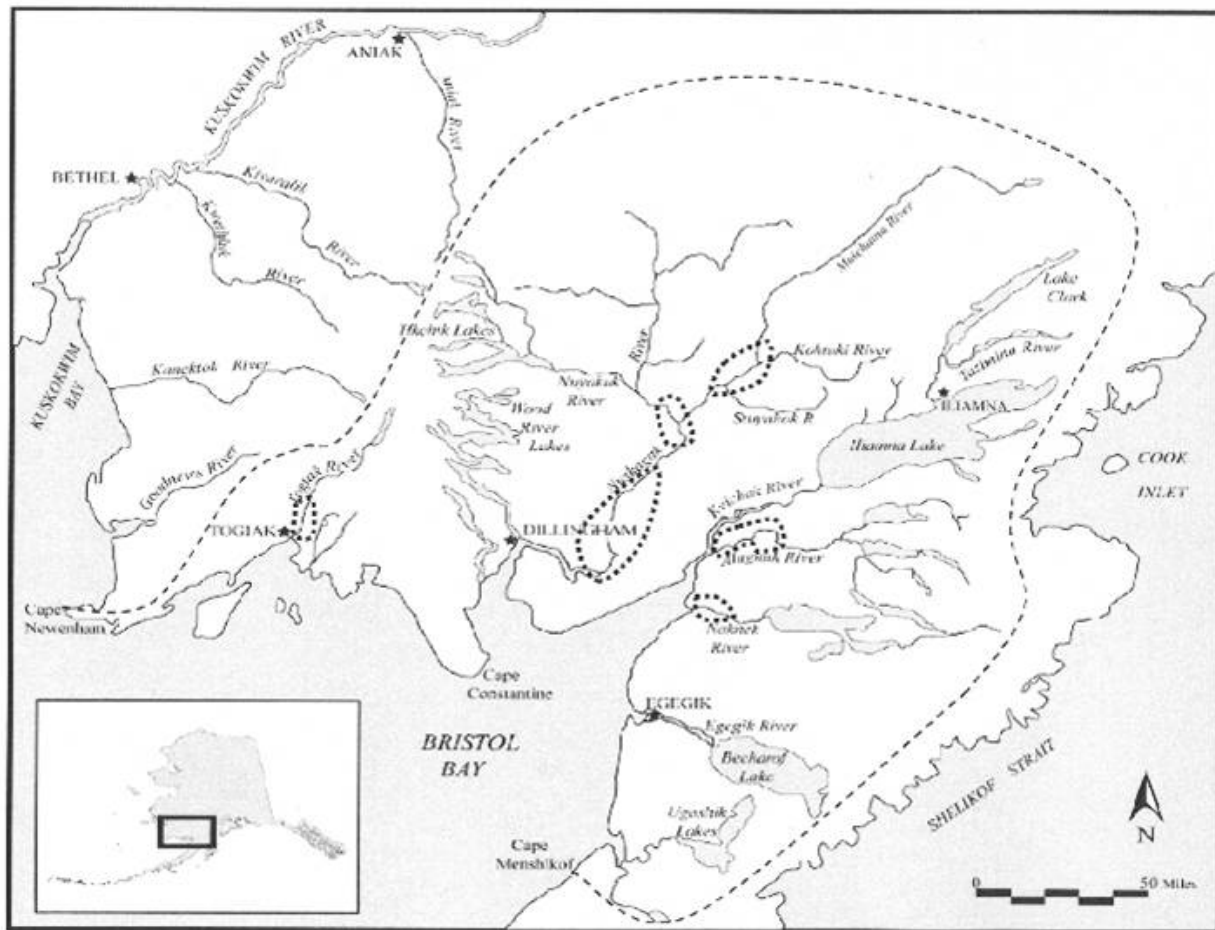


Figure 1.—Popular Chinook salmon fisheries in the Bristol Bay Management Area.



Table 1.—Escapement and commercial, subsistence, and sport harvests of Chinook salmon for the Nushagak drainage, 1986–2007.

Year	Total run <sup>a</sup>	Harvests below sonar				Inriver sonar estimate	Harvests above sonar		Spawning escapement		Total sport harvest
		Commercial harvest <sup>b</sup>	Commercial subsistence removals <sup>c</sup>	Subsistence harvest <sup>d</sup>	Sport harvest <sup>e</sup>		Subsistence harvest <sup>f</sup>	Sport harvest <sup>g</sup>	Sonar estimate <sup>h</sup>	Aerial survey estimate <sup>i</sup>	
1986	117,478	65,783	798	6,834	628	43,434	4,725	4,162	34,547		4,790
1987	139,814	45,983	318	7,919	1,286	84,309	3,139	3,173	77,997		4,458
1988	80,184	16,648	528	4,911	1,192	56,905	4,037	1,626	51,242		2,817
1989	102,872	17,637	632	4,898	1,404	78,302	2,217	2,210	73,875		3,613
1990	86,990	14,812	1,197	6,228	797	63,955	3,325	2,689	57,941		3,486
1991	134,740	19,718	1,971	6,907	1,793	104,351	3,127	3,758	97,466		5,551
1992	140,850	47,563	907	7,688	1,844	82,848	2,499	2,911	77,438		4,755
1993	175,609	62,971	1,867	10,552	2,408	97,812	2,919	3,492	91,401		5,899
1994	229,581	119,478	1,126	8,587	4,436	95,954	3,775	6,191	85,989		10,626
1995	177,801	79,942	1,327	8,672	2,238	85,622	2,420	2,713	80,489		4,951
1996	136,812	72,011	730	9,598	2,346	52,127	3,055	3,045	46,027		5,390
1997	155,962	64,160	544	8,328	931	40,705	3,192	2,567		82,000	3,497
1998	242,686	117,065	805	5,682	1,640	117,495	4,440	4,188	108,868		5,827
1999	79,973	10,893	927	4,888	934	62,331	2,477	3,304	56,551		4,237
2000	75,172	12,055	1,052	4,302	1,389	56,374	2,132	4,628	49,615		6,016
2001	119,527	11,568	1,078	6,126	1,600	99,155	3,372	4,299	91,484		5,899
2002	133,574	39,473	717	5,050	1,193	87,141	4,104	2,500	80,537		3,693
2003	133,653	42,615	672	8,135	2,203	80,028	4,448	3,752	71,828		5,955
2004	226,734	100,601	440	6,726	2,567	116,400	4,378	4,339	107,683		6,906
2005	241,949	62,308	532	4,339	2,863	171,907	4,471	5,702	161,734		8,565
2006	218,946	84,010	956	6,131	3,166	124,683	3,012	4,307	117,364		7,473
2007	125,498	51,473	416	9,564	3,581	60,464	3,411	6,088	50,965		9,669
<b>Average</b>											
1986–2006	149,262	52,728	911	6,786	1,850	85,802	3,394	3,598	81,004		5,448
2002–2006	164,222	50,376	778	5,830	2,140	105,098	3,702	4,218	97,178		6,358

<sup>a</sup> Total run is the sum of the inriver sonar estimate plus harvests below the sonar.

<sup>b</sup> Total Nushagak District commercial harvest. Sources: 1986–1992 (Sands et al. 2008, Appendix A4, page 84); Sources: 1993–2007 (Jones et al. 2009, Appendix A4, page 80).

<sup>c</sup> Nushagak Bay commercial harvest from the Subsistence database. Source: ADF&G Subsistence database from James Fall, Division of Subsistence, Region II, Anchorage, November 2007

<sup>d</sup> Includes Nushagak Bay and Igushik. Source: ADF&G Subsistence database from Charles Utermohle, Program Coordinator, Division of Subsistence, Region II, Anchorage, 20 November 2000. Data for the years 2000–2007 provided by James Fall, Division of Subsistence, Region II, Anchorage.

<sup>e</sup> For 1986–1996, data reflect 50% of the Nushagak River System sport harvest. For 1997–2007, data are from the Nushagak River from Black Point to the sonar location. Source: Mills (1987-1994); Howe et al. (1995-1996, 2001a-d); Walker et al. (2003); Jennings et al. (Jennings et al. 2004, 2006a-b, 2007, 2009a-b, 2010).

<sup>f</sup> 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 database from James Fall, Division of Subsistence, Region II, Anchorage, 20 November 2000. Data for the years 2000–2007 provided by James Fall, Division of Subsistence, Region II, Anchorage.

<sup>g</sup> For 1986–1996, data reflect 50% of Nushagak River System sport harvest plus the Mulchatna River System, Tikchik/Nuyakuk River, and Koktuli River harvests reported in Mills (1987-1994) and Howe et al. (1995-1996, 2001a). For 1997–2001, data reflect 50% of the Nushagak River harvest from all of the following: Black Point to Iowithla, Nushagak River upstream of Iowithla, the Mulchatna River System, Tikchik/Nuyakuk River and Koktuli River (Howe et al. 2001b-d; Walker et al. 2003; Jennings et al. 2004). For 2002–2007, data reflect Nushagak River excluding Black Point to the sonar location (Jennings et al. 2006a-b, 2007, 2009a-b, 2010).

<sup>h</sup> Estimates for 1986–1996 and 1998–2007 are the sonar estimates minus subsistence and sport harvest above the sonar location.

<sup>i</sup> Source: ADF&G 2000.

As mentioned above, ADF&G's statewide freshwater guided sport fishing reporting program collects annual data on effort, catch, harvest, and angler demographic characteristics for guided anglers. However, because unguided angler effort on the lower Nushagak River appears to be increasing and because ADF&G does not have recent data on this important and growing segment of anglers, this survey documents current levels of effort, catch, and harvest rates, and angler demographic characteristics of unguided anglers as well.

Data on the sport fisheries in the Nushagak River drainage include the results of the annual ADF&G Division of Sport Fish Statewide Harvest and Participation Survey (Mills 1979-1994; Howe et al. 1995-1996, 2001a-d; Walker et al. 2003; Jennings et al. 2004, 2006a-b, 2007, 2009a-b, 2010), seven on-site creel surveys conducted in 1985, 1986, 1987, 1991, 1994, 2000, and 2001 (Minard and Morstad 1985; Minard 1987; Minard and Brookover III 1988; Dunaway and Bingham 1992; Dunaway and Fleischman 1995; Dye 2005; Cappiello and Dye 2006), and ADF&G's statewide freshwater guided sport fishing reporting program (Sigurdsson and Powers 2009). Creel surveys conducted by ADF&G in 1997 in the lower reaches of the Nushagak River and middle Mulchatna River were terminated early by a closure of the Chinook salmon fishery. Results of the 1997 surveys were briefly summarized in the 1997 Southwest Alaska area management report (Minard et al. 1998). Management reports for the Southwest Alaska area document the management of the Nushagak River Chinook salmon sport fishery (Minard and Dunaway 1995; Minard et al. 1998; Dunaway et al. 2000). Information on the commercial and subsistence salmon harvests and salmon escapements into the Nushagak River drainage are collected annually by the ADF&G Division of Commercial Fisheries and published annually in their Regional Information Report series.

## **OBJECTIVES**

The objectives for the 2007 survey of the Chinook salmon sport fishery on the Nushagak River near Portage Creek were as follows:

- 1) Index guided, unguided, and total angler effort in angler-days in the lower Nushagak River from 15 June to 10 July.
- 2) Index catch and harvest rates of Chinook salmon, and composition of unguided angler-days, by gear in the lower Nushagak River from 15 June to 10 July.
- 3) Estimate the age, sex, length, and weight compositions of Chinook salmon in the sport harvest, separately and in total, for both guided and unguided anglers in the lower Nushagak River from 15 June to 10 July such that the estimates are within 10 percentage points of the true values 90% of the time.

## **TASKS**

The tasks for the 2007 survey of the Chinook salmon sport fishery on the Nushagak River near Portage Creek were as follows:

- 1) Calculate guided angler effort in angler-days in the lower Nushagak River from 15 June to 10 July using data collected in the Alaska Department of Fish and Game statewide freshwater guided sport fishing reporting program.

- 2) Calculate guided angler catch and harvest rates of Chinook salmon and composition of angler-days by gear in the lower Nushagak River from 15 June to 10 July using data collected in the Alaska Department of Fish and Game statewide freshwater guided sport fishing reporting program.

## **METHODS**

### **STUDY AREA**

This survey of the Nushagak River Chinook salmon recreational fishery occurred on the Nushagak River from Black Point to the lower Ekwok land boundary (LELB) at lat 59°10'25"N, long 157°42'35"W (Figures 2 and 3). This area was divided into 3 sublocations: 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) (Figure 3).

### **STUDY DESIGN**

Staff from ADF&G Division of Sport Fish (SF) counted guided and unguided anglers and only interviewed unguided completed-day anglers (unguided anglers who were done angling for the day). Two SF staff were stationed in the study area to conduct angler counts and interviews. SF staff also sampled biological data from Chinook salmon harvested by both guided and unguided anglers in the study area. The sample schedule incorporated seasonal, weekly, and daily peaks in the Chinook salmon sport fishery based on local knowledge of the fishery from SF staff and Choggiung Ltd. (Alaska Native village corporation for Dillingham, Ekuuk, and Portage Creek). The survey was stratified by week (Monday–Sunday) and day type (weekend, weekday). Sampling took place on Friday through Tuesday of each week.

### **Angler effort, catch, and harvest rates, and angler-day compositions**

Only 1 angler count was conducted during each sample day. All counts began at the same time of day and were thought to represent the peak time of angling activity. Angler counts began at 10:00 AM each sample day and took between 1.5 and 2.5 hours to complete. The counts were not used to estimate angler effort because all possible count times were not surveyed. These counts can provide an unbiased index of angler effort during the days and time sampled, assuming that 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 did vary during the course of the survey (e.g., anglers shifted from morning to evening fishing), then the counts would not be considered an unbiased index of angler effort.

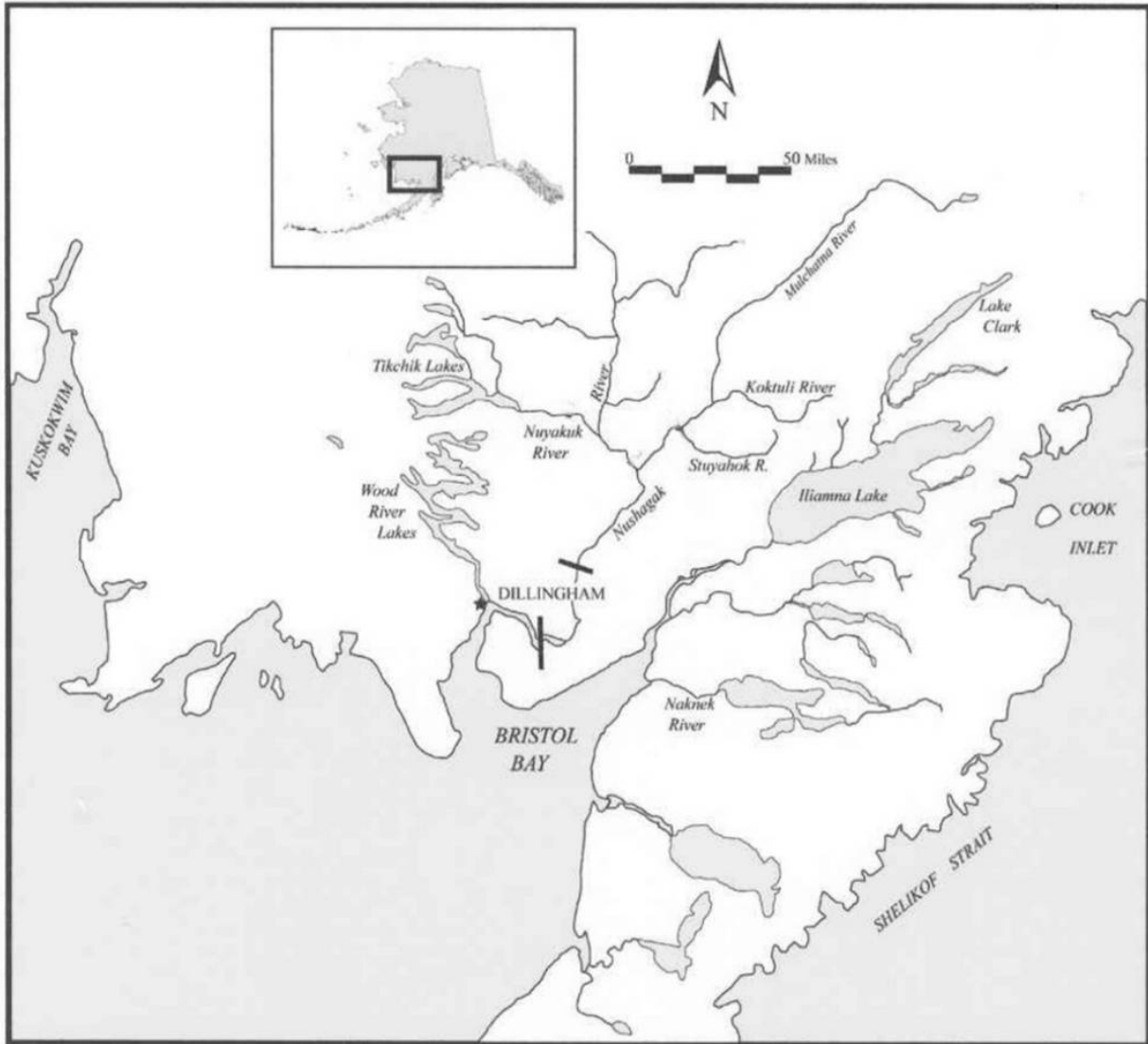


Figure 2.—Nushagak River Chinook salmon sport fishery study site.

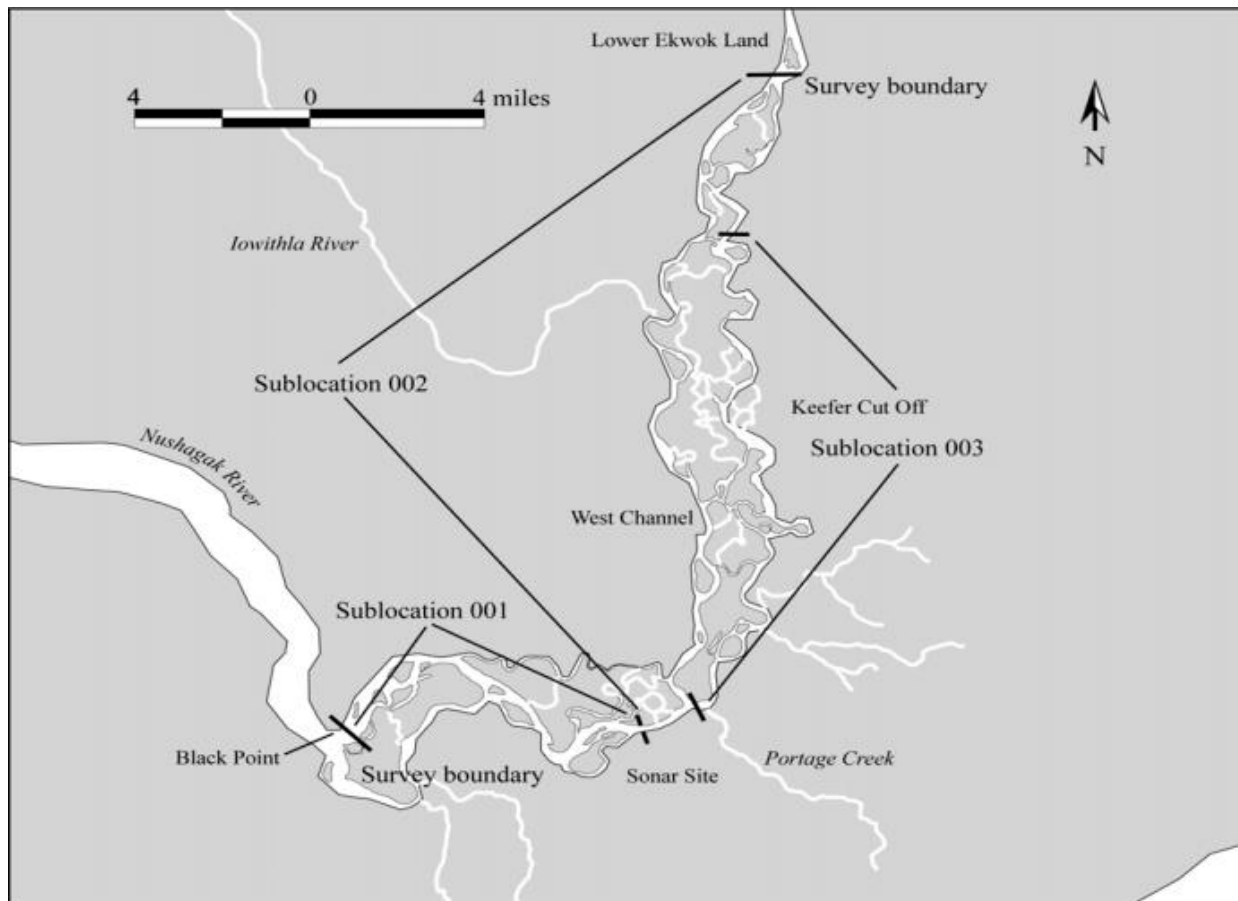


Figure 3.—Nushagak River Chinook salmon sport fishery study area sublocations.

Unguided completed-day anglers were interviewed to obtain data on catch and harvest rates, composition (proportion) of angler-days by gear (i.e., use or no use of bait), and angler demographic characteristics (residency and gender). Given the study design, if different types of anglers (guided vs. unguided) or anglers with a different catch or harvest rate fished during hours of the day not covered by the interviews, then estimates based on interviews would not be considered representative of the whole unguided fishery in the lower area.

SF staff interviewed only unguided completed-day anglers. Locating and identifying this angler group required coordination among Choggiung Ltd. and SF staff. Interviews resulted both from roving through the fishery and by stopping during the evening at unguided angler camps. Interviewing as many anglers as possible from this group each day provided some insight into their demographic 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.

### **Biological composition of harvested fish**

Biological data from Chinook salmon harvested by both guided and unguided anglers were collected in the lower Nushagak River. The two SF staff members roved the study area on sample days to collect age, sex, length, and weight data from all sport-harvested fish

encountered. Data were reported separately by angler type (guided or unguided). Assuming 15% of the scales collected could not be aged, at least 120 Chinook salmon harvested by guided anglers and 120 harvested by unguided anglers (total of 240), needed to be sampled to attain the desired precision of estimates (Thompson 2002).

### **Guided Angler effort, catch, and harvest rates, and angler-day compositions**

Effort, catch, and harvest rates, and angler-day composition of guided anglers in the lower Nushagak River during 2007 was calculated using data collected in the ADF&G statewide freshwater guided sport fishing reporting program. Guided effort data were compared to historical guided effort levels in the lower Nushagak River. Additionally, catch and harvest rates of guided anglers were compared to unguided anglers' catch and harvest rates estimated in the angler survey described above as well as with historical catch and harvest rates in the lower Nushagak River.

## **DATA COLLECTION**

### **Angler effort**

SF staff counted all active anglers while driving a boat at a constant rate of speed through the study area. Guided and unguided anglers were visually identified, counted, and recorded separately. Differentiation between guided and unguided anglers during the counts required the technicians to identify the presence or absence of green ADF&G guide decals on boats with anglers. No stops were made except at sublocation boundaries to record start and finish times and angler counts. Active anglers were defined as individuals fishing, 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 had put their gear away to eat lunch).

Angler counts are considered instantaneous and representative of angler effort when the counts were conducted. The start time was chosen to index angler effort during what was considered the peak time of day of angling activity in each study area. Angler counts, count start and stop times by sublocation, staff initials, and brief observations were recorded on study area-specific data forms provided by SF. The crew leader ensured count data were collected and recorded. Periodically throughout the study, the data were submitted to the principal investigator for review.

Angler counts were recorded for guided and unguided anglers in each of three sublocations (Figure 3). Two SF technicians conducted the counts. One technician began at Black Point and counted anglers while traveling upstream to the sonar site near Portage Creek. In a separate boat, the other technician 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 (Figure 3). Both individuals began their counts at the same time (10:00 AM).

From 15 June through 10 July, staff recorded the start and stop times and angler counts. In the rare event of a missed count, the scheduled date and time, sublocation, and reason for the interruption were recorded on the data form.

## Angler interviews

Angler interviews were conducted throughout the study area. SF staff only interviewed unguided anglers. Only completed-day anglers of this type were interviewed. Data were recorded for each angler, not a group interview. Staff recorded interview type (completed-day), number of Chinook salmon kept and the number released, angler demographic characteristics (gender and residency), and gear type (use or no use of bait).

## Biological composition of harvested fish

Sport harvested Chinook salmon encountered during each sampling day in the lower river were sampled by SF staff for age, sex, length, and weight. Staff determined whether the sampled fish were harvested by guided or unguided anglers and recorded them separately by these angler-types. When possible, all Chinook salmon retained by an angler or group of anglers were sampled (i.e., no subsampling of the creel). The sampling design is expected to yield a proportional sample of the harvest through the progression of the fishery (i.e., equal proportion of the harvest). The resultant data were treated as if collected from a simple random sample.

Harvested Chinook salmon were measured for length to the nearest millimeter from mid eye to tail fork (METF), weighed to the nearest 0.25 kilograms, and sex was determined by external characteristics (ovipositor on females or a developing kype on males). In addition, three scales were removed from the preferred area<sup>1</sup> and mounted on an adhesive-coated card. Standard age determination procedures were used (see Jearld [1983] for a general description). 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 (e.g., age 2.4 designates two freshwater annuli and four marine annuli). Total age from the brood year is the sum of the 2 numerals plus 1.

## DATA ANALYSIS

### Angler effort

As noted above, the single angler count conducted each day represents an index of angler effort. Only a summary of the daily counts by study area and sublocation was performed.

### Angler interviews

#### *Catch and harvest rate*

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

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

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  $n_{hi}$  is the number of complete-day anglers interviewed on the  $i^{th}$  day.

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<sup>1</sup> The left side of the fish approximately two rows above the lateral line and on a diagonal line downward from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Welanders 1940).

The weekly mean estimate of CPUE is simply

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

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

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

The standard error (SE) was estimated as the square root of the variance estimate. Confidence intervals (95%) were estimated using the percentile bootstrap method (Efron and Tibshirani 1993) to compare CPUE among weeks. Harvest per unit of effort (HPUE) was estimated similarly, replacing harvest (only fish that were kept) for catch.

### ***Angler compositions***

The proportion of anglers by terminal gear type (bait use) or angler demographic characteristics (residency or gender)  $z$  was estimated as

$$\hat{p}_z = \frac{m_z}{m}, \quad (4)$$

where  $m_z$  equals the number of interviewed anglers whose trips were categorized as  $z$ , and where  $m$  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 as follows:

- 1) interviewed anglers accurately report the number of Chinook salmon kept and released;
- 2) division staff accurately classify anglers and the interviewed anglers accurately report their trip type, demographic characteristics, and terminal gear type (use of bait) during their fishing day;
- 3) catch rate and duration of fishing trip are 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);
- 4) the distribution of angler effort within the angling day does 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).



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 accurately report their fishing day characteristics. In addition, project staff were expected to accurately record interview data. Assumptions 3 and 4 should be valid if collected interviews resulted in a census of unguided completed-day anglers. If the collected interviews did not result in a census, then the interviews needed to be collected in proportion to the total number of anglers present throughout the study. The angler counts can be used as a diagnostic for this. Proportional samples will be realized if the ratio of the angler count to the number of interviews performed on a given day remained stable throughout the study.

### **Biological composition of harvested fish**

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

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

where  $n_u$  equals the number of sampled Chinook salmon in category  $u$ , and where  $n$  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:

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

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

## **RESULTS**

### **ANGLER EFFORT**

Angler counts were conducted from 16 June through 10 July 2007 (Tables 2–4). Counts were missed on 5 days through the duration of the project. Counts of unguided anglers in sublocation 001 ranged from 1 on 10 July to 54 on 22 June and averaged 25 (Table 2). Counts of guided anglers in sublocation 001 ranged from 16 on 16 June to 143 on 30 June and averaged 99 (Table 3). Total counts for sublocation 001 ranged from 20 on 16 June to 195 on 22 June and averaged 124 (Table 4). In sublocation 002, counts of unguided anglers ranged from 0 on 10 July to 29 on 29 June and averaged 13; counts of guided anglers ranged from 6 on 16 June to 119 on 22 June and averaged 69; and total counts ranged from 8 on 16 June to 132 on 22 June and averaged 82. In sublocation 003, counts of unguided anglers ranged from 0 on 9 July to 45 on 26 June and averaged 15; counts of guided anglers ranged from 4 on 10 July to 35 on 24 June and averaged 17; and total counts ranged from 6 on 9 and 10 July to 63 on 26 June and averaged 32.

Table 2.—Unguided angler counts, by date and sublocation, during the survey on the lower Nushagak River, 16 June–10 July 2007.

Date	Sublocation			Total
	001	002	003	
16 Jun	4	2	4	10
17 Jun	Missed	Missed	Missed	Missed
18 Jun	Missed	Missed	Missed	Missed
19 Jun	38	10	21	69
20 Jun	OFF	OFF	OFF	OFF
21 Jun	OFF	OFF	OFF	OFF
22 Jun	54	13	Missed	67
23 Jun	39	Missed	Missed	39
24 Jun	33	10	10	53
25 Jun	25	14	9	48
26 Jun	17	10	45	72
27 Jun	OFF	OFF	OFF	OFF
28 Jun	OFF	OFF	OFF	OFF
29 Jun	44	29	27	100
30 Jun	20	17	40	77
1 Jul	42	24	Missed	66
2 Jul	12	12	23	47
3 Jul	28	23	1	52
4 Jul	OFF	OFF	OFF	OFF
5 Jul	OFF	OFF	OFF	OFF
6 Jul	OFF	OFF	OFF	OFF
7 Jul	18	23	8	49
8 Jul	17	18	6	41
9 Jul	11	3	0	14
10 Jul	1	0	2	3
Total	403	208	196	807

Table 3.–Guided angler counts, by date and sublocation, during the survey on the lower Nushagak River, 16 June–10 July 2007.

Date	Sublocation			Total
	001	002	003	
16 Jun	16	6	17	39
17 Jun	Missed	Missed	Missed	Missed
18 Jun	Missed	Missed	Missed	Missed
19 Jun	84	40	16	140
20 Jun	OFF	OFF	OFF	OFF
21 Jun	OFF	OFF	OFF	OFF
22 Jun	141	119	Missed	260
23 Jun	133	Missed	Missed	133
24 Jun	126	50	35	211
25 Jun	126	91	20	237
26 Jun	140	97	18	255
27 Jun	OFF	OFF	OFF	OFF
28 Jun	OFF	OFF	OFF	OFF
29 Jun	129	71	29	229
30 Jun	143	80	15	238
1 Jul	109	93	Missed	202
2 Jul	134	80	20	234
3 Jul	124	73	10	207
4 Jul	OFF	OFF	OFF	OFF
5 Jul	OFF	OFF	OFF	OFF
6 Jul	OFF	OFF	OFF	OFF
7 Jul	50	64	6	120
8 Jul	72	55	9	136
9 Jul	61	91	6	158
10 Jul	38	73	4	115
Total	1626	1083	205	2914

Table 4.–Total angler counts, by date and sublocation, during the survey on the lower Nushagak River, 16 June–10 July 2007.

Date	Sublocation			Total
	001	002	003	
16 Jun	20	8	21	49
17 Jun	Missed	Missed	Missed	Missed
18 Jun	Missed	Missed	Missed	Missed
19 Jun	122	50	37	209
20 Jun	OFF	OFF	OFF	OFF
21 Jun	OFF	OFF	OFF	OFF
22 Jun	195	132	Missed	327
23 Jun	172	Missed	Missed	172
24 Jun	159	60	45	264
25 Jun	151	105	29	285
26 Jun	157	107	63	327
27 Jun	OFF	OFF	OFF	OFF
28 Jun	OFF	OFF	OFF	OFF
29 Jun	173	100	56	329
30 Jun	163	97	55	315
1 Jul	151	117	Missed	268
2 Jul	146	92	43	281
3 Jul	152	96	11	259
4 Jul	OFF	OFF	OFF	OFF
5 Jul	OFF	OFF	OFF	OFF
6 Jul	OFF	OFF	OFF	OFF
7 Jul	68	87	14	169
8 Jul	89	73	15	177
9 Jul	72	94	6	172
10 Jul	39	73	6	118
Total	2029	1291	401	3721

## ANGLER INTERVIEWS

During the 2007 creel survey, 123 interviews of unguided anglers were conducted from 19 June through 10 July. Mean weekly estimates of CPUE per angler ranged from 0.84 fish per day during the week 2–10 July to 3.53 fish per day during the week 25 June–1 July. For the entire duration of the study, CPUE per angler averaged 1.92 fish per day. Weekly estimates of HPUE per angler ranged from 0.40 fish per day during the week 19–24 June to 0.81 fish per day during the week 25 June–1 July. For the entire duration of the study, HPUE per angler averaged 0.42 fish per day (Table 5). Most unguided anglers were residents of Alaska (59%) and most were local residents of Alaska (52%) (Table 6). Most anglers were adult (88%) and most were males (80%). Most anglers exclusively used bait (57%).

Table 5.–Catch and harvest per unit effort for unguided anglers in the Chinook salmon sport fishery in the lower Nushagak River, 19 June–10 July 2007.

Temporal component	CPUE <sup>a</sup>	SE	95% confidence interval		HPUE <sup>b</sup>	SE	95% confidence interval	
			Lower	Upper			Lower	Upper
1 (19–24 June)	2.13	1.16	0	5.81	0.40	0.21	0	1.07
2 (25 June–1 July)	3.53	0.82	1.25	5.81	0.81	0.29	0.01	1.61
3 (2–10 July)	0.84	0.23	0.1	1.58	0.42	0.09	0.13	0.71
Entire season	2.27	0.55	1.08	3.46	0.42	0.13	0.13	0.71

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

<sup>b</sup> Number of fish harvested per angler-day of effort.

Table 6.–Number and percent of angler trips by angler and gear type during the Chinook salmon sport fishery on the lower Nushagak River, 16 June–10 July 2007.

Characteristic	Unguided angler trips	Percent
<u>Residency</u>		
Alaska residents	72	59
Local Alaska residents <sup>a</sup>	64	52
Nonlocal Alaska residents <sup>b</sup>	8	7
Non-Alaska residents	51	41
U.S. resident	51	100
Non-U.S. resident	0	0
<u>Gender</u>		
Male	99	80
Female	24	20
<u>Tackle type</u>		
No bait	53	43
Bait	70	57
<b>Total unguided angler trips</b>	<b>123</b>	<b>100</b>

<sup>a</sup> Alaska resident living in Aleknagik, Dillingham, Portage Creek, Ekwok, New Stuyahok, or Koliganek.

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

## BIOLOGICAL COMPOSITION OF HARVESTED FISH

A total of 231 harvested Chinook salmon were sampled for biological information: 104 from unguided anglers and 127 from guided anglers (Tables 7, 8, and 9). Harvested Chinook salmon sampled from unguided anglers were 65% male (SE 0.05) and 35% female (SE 0.05); average length was 776 mm and average weight was 8.1 kg; the predominant ages were 1.3 (39%; SE 0.05) and 1.4 (40%; SE 0.05) (Table 8). Harvested Chinook salmon sampled from guided anglers were 62% male (SE 0.05) and 38% female (SE 0.05); average length was 734 mm and average weight was 8.1 kg; the predominant ages were 1.3 (36%; SE 0.05) and 1.4 (36%; SE 0.05) (Table 9). Combining all samples, 64% were males (SE 0.03) and 36% were females (SE 0.03); average length was 752 mm (SE 10.0) and average weight was 8.1 kg (SE 0.24); the predominant ages were 1.3 (37%; SE 0.03) and 1.4 (38%; SE 0.03) (Table 7).

Table 7.—Mean lengths (mm) and weights (kg) of Chinook salmon, by sex and age group, from all samples collected from the lower Nushagak River sport harvest, 16 June–10 July 2007.

	Unknown age	Age group					Total
		1.1	1.2	1.3	1.4	1.5	
<u>Females</u>							
Percent		0	0	11	24	1	36
SE		0	0	0.02	0.03	0.01	0.03
Sample size		0	0	24	50	3	77
Mean length	859	0	0	774	871	969	847
SE	26.20	0	0	12.50	7.70	39.20	8.30
Sample size	14	0	0	24	50	3	91
Mean weight	11.1	0	0	9.0	11.0	14.5	10.6
SE	0.63	0	0	0.47	0.33	1.22	0.27
Sample size	14	0	0	24	50	3	91
<u>Males</u>							
Percent		4	19	26	14	1	64
SE		0.01	0.03	0.03	0.02	0.01	0.03
Sample size		8	39	54	29	2	132
Mean length	722	373	554	740	839	1060	691
SE	54.91	6.67	17.38	5.91	11.12	124.00	13.30
Sample size	8	8	39	54	29	2	140
Mean weight	6.7	1.3	3.6	7.2	9.3	16.9	6.4
SE	0.94	0.37	0.27	0.19	0.41	4.40	0.27
Sample size	8	8	39	54	29	2	140
<u>All samples</u>							
Percent		4	19	37	38	2	100
SE		0.01	0.03	0.03	0.03	0.01	0.00
Sample size		8	39	78	79	5	209
Mean length	809	373	554	751	859	1005	752
SE	29.02	6.67	17.38	5.86	6.55	49.97	10.03
Sample size	22	8	39	78	79	5	231
Mean weight	9.5	1.3	3.6	7.8	10.4	15.5	8.1
SE	0.69	0.37	0.27	0.21	0.27	1.65	0.24
Sample size	22	8	39	78	79	5	231

Table 8.—Mean lengths (mm) and weights (kg) of Chinook salmon, by sex and age group, from samples collected from the lower Nushagak River unguided sport harvest, 16 June–10 July 2007.

	Unknown age	Age Group					Total
		1.1	1.2	1.3	1.4	1.5	
<u>Females</u>							
Percent		0	0	7	26	2	35
SE		0	0	0.03	0.05	0.01	0.05
Sample size		0	0	7	25	2	34
Mean length	892	0	0	816	876	1007	874
SE	25.94	0.00	0.00	21.67	10.10	17.00	10.24
Sample size	5	0	0	7	25	2	39
Mean weight	11.5	0	0	8.0	10.5	15.7	10.5
SE	0.11	0.00	0.00	0.48	0.41	0.85	0.40
Sample size	5	0	0	7	25	2	39
<u>Males</u>							
Percent		3	16	31	14	1	65
SE		0.02	0.04	0.05	0.04	0.01	0.05
Sample size		3	15	30	13	1	62
Mean length	810	360	567	737	867	1184	716
SE	37.75	12.67	29.15	6.99	16.39	0.00	19.23
Sample size	3	3	15	30	13	1	65
Mean weight	8.1	1.8	3.7	7.1	8.5	21.3	6.6
SE	0.83	1.00	0.48	0.22	0.28	0.00	0.38
Sample size	3	3	15	30	13	1	65
<u>All samples</u>							
Percent		3	16	39	40	3	100
SE		0.02	0.04	0.05	0.05	0.02	0.00
Sample size		3	15	37	38	3	96
Mean length	862	360	567	752	873	1066	776
SE	24.91	12.67	29.15	8.57	8.58	59.81	14.65
Sample size	8	3	15	37	38	3	104
Mean weight	10.2	1.8	3.7	7.2	9.9	17.5	8.1
SE	0.95	1.00	0.48	0.21	0.33	1.95	0.33
Sample size	8	3	15	37	38	3	104

Table 9.—Mean lengths (mm) and weights (kg) of Chinook salmon, by sex and age group, from samples collected from the lower Nushagak River guided sport harvest, 16 June–10 July 2007.

	Unknown	Age Group					Total
	age	1.1	1.2	1.3	1.4	1.5	
<b>Females</b>							
Percent		0	0	15	22	1	38
SE		0	0	0.03	0.04	0.01	0.05
Sample size		0	0	17	25	1	43
Mean length	840	0	0	757	867	893	827
SE	37.84	0.00	0.00	13.51	11.78	0.00	11.71
Sample size	9	0	0	17	25	1	52
Mean weight	10.9	0	0	9.5	11.5	12.3	10.8
SE	0.80	0.00	0.00	0.61	0.50	0.00	0.36
Sample size	9	0	0	17	25	1	52
<b>Males</b>							
Percent		4	21	21	14	1	62
SE		0.02	0.04	0.04	0.03	0.01	0.05
Sample size		5	24	24	16	1	70
Mean length	670	380	545	744	817	936	669
SE	78.56	6.01	21.89	10.15	12.98	0.00	18.14
Sample size	5	5	24	24	16	1	75
Mean weight	5.9	0.9	3.5	7.4	9.9	12.5	6.2
SE	1.34	0.08	0.32	0.31	0.68	0.00	0.39
Sample size	5	5	24	24	16	1	75
<b>All samples</b>							
Percent		4	21	36	36	2	100
SE		0.02	0.04	0.05	0.05	0.01	0.00
Sample size		5	24	41	41	2	113
Mean length	779	380	545	749	847	915	734
SE	41.93	6.01	21.89	8.13	9.50	21.50	13.58
Sample size	14	5	24	41	41	2	127
Mean weight	9.1	0.9	3.5	8.3	10.9	12.4	8.1
SE	0.94	0.08	0.32	0.34	0.42	0.10	0.34
Sample size	14	5	24	41	41	2	127

## GUIDED ANGLER EFFORT, CATCH AND HARVEST RATES, AND ANGLER-DAY COMPOSITIONS

On the lower Nushagak River, from 15 June through 10 July 2007, a total of 6,738 guided angler-days were documented in the ADF&G statewide freshwater guided sport fishing reporting program (Table 10). Anglers had a HPUE for Chinook salmon of 0.58 fish per day and a CPUE of 3.57 fish per day (Table 10). Currently, the statewide freshwater guided sport fishing reporting program does not collect information on gear type; therefore, composition of angler-days by gear type was not estimated.

Table 10.—Effort, catch, harvest, HPUE, and CPUE of Chinook salmon for guided anglers in the lower Nushagak River, 15 June–10 July 2006 and 2007.

Year	Dates	Effort (angler-days)	Chinook salmon harvested	Chinook salmon released	Total Chinook salmon caught	HPUE	CPUE
2006	15 June–10 July	7,362	4,451	25,530	29,981	0.60	4.07
2007	15 June–10 July	6,738	3,905	20,144	24,049	0.58	3.57



## DISCUSSION

Beginning in 2005, in addition to the Statewide Harvest Survey, ADF&G began collecting effort, catch, and harvest information from all commercially guided anglers in the statewide freshwater guided sport fishing reporting program. The study design for the 2007 survey of the Nushagak Chinook salmon sport fishery differed significantly from most previous studies because of the addition of this new reporting program (Dunaway and Bingham 1992; Dunaway and Fleischman 1995; Dye 2005; Cappiello and Dye 2006). The primary difference between the old and new study design was that, with the exception of effort and biological composition of the sport harvest, the new survey was designed to collect information and document use by unguided anglers only. A number of differences in the new study design preclude or otherwise complicate comparisons with results from surveys prior to 2000. These differences include changes in study area boundaries, changes in sampling schedules, and the collection of data from only 1 group of anglers (unguided). The main impetus for the new study design was the introduction of the freshwater guided sport fishing reporting program. Rather than expand the study design to estimate elements of the whole fishery, the new study was designed to monitor harvest and catch rates, effort distribution and trends, and angler demographic characteristics of unguided anglers.

The Chinook salmon sport fishery in the Nushagak River typically peaks during the last week of June or the first week of July, earlier than most other drainages in Bristol Bay, and 2007 was no exception.

In previous studies, separate counts for unguided and guided anglers were not conducted; therefore, only combined guided and unguided effort is comparable. Peak daily angler counts during this study were less than those from 2000 and 2001, when peak counts of 404 and 365 anglers, respectively, occurred on 26 June. During 2007, the peak angler count of 329 occurred on 29 June (Table 4). The total season angler count during this study was 3,721 (Table 4) compared to 4,255 and 4,270 anglers, respectively, counted during 2000 and 2001. Reasons for this decline in effort are unknown, but likely reflect the downturn in national and global economies.

Because ADF&G staff interviewed only unguided anglers, rather than all anglers, the CPUE and HPUE resulting from those interviews are not directly comparable with prior studies. Daily and weekly CPUE during 2007 clearly coincided with Chinook salmon passage estimates at the sonar site (Figure 4). Historically, guided anglers have substantially higher CPUE than non-guided anglers and, based on logbook data, 2007 was no exception (Minard 1987; Marsh 2000; Gryska and Naughton 2001; Dye 2005; Cappiello and Dye 2006). The CPUE and HPUE for guided anglers were similar during 2006 and 2007 (Table 10).

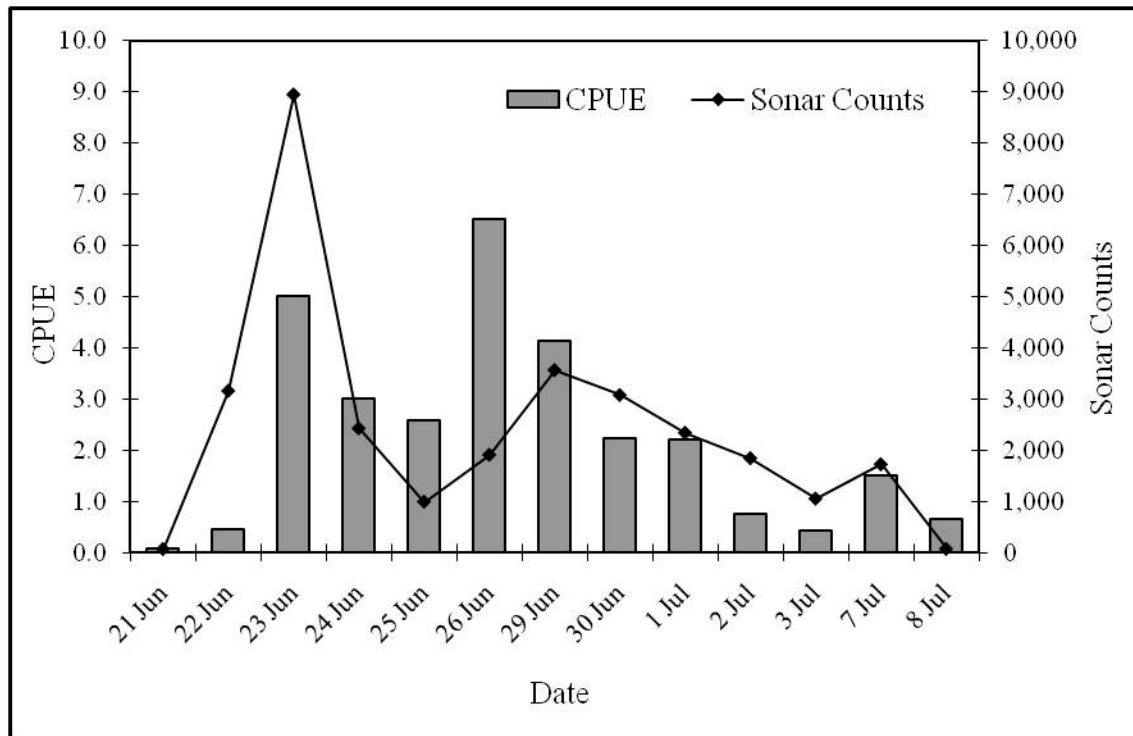


Figure 4.—Daily catch per unit effort of Chinook salmon by unguided anglers compared to sonar counts of Chinook salmon, Nushagak River, 2007.

Again, because ADF&G staff interviewed only unguided anglers rather than all anglers, the demographic characteristics resulting from those interviews are not directly comparable with studies prior to 2000. Most of the characteristics of unguided anglers were similar to those described in 2000 and 2001. The biggest differences were in percentage of Alaska residents (59% in 2007; 63% in 2001; 49% in 2000) and locals (52% in 2007; 34% in 2001; 25% in 2000) (Table 6). As in 2000 and 2001, bait continued to be used by a majority of unguided anglers, indicating that restriction of bait remains a potentially effective management tool for conservation of Chinook salmon during low run years.

The age composition of Chinook salmon harvested in the sport fishery appears to have shifted toward younger fish since the 2001 survey. Age-1.2 Chinook salmon respectively composed 6%, 9%, and 19% of the sampled sport harvests in 2000, 2001, and 2007. While 2% of the sport harvest was age 1.5 in 2007, this age class composed 34% of the sport harvest in 2000 and 10% in 2001. Overall mean length and weight in 2007 were on the low end of historical ranges. This is likely due, in part, to a regulation adopted in 2004 allowing anglers to harvest 5 Chinook salmon less than 20 inches in length per day with no seasonal limit.

Unlike many of the previous surveys, this survey was most useful in characterizing the use of the lower Nushagak River Chinook salmon fishery by the resident unguided angler who either flew in from Southcentral or interior Alaska and camped on the river or boated in from Dillingham for the day. We recommend using similar methods in future surveys of the Nushagak River Chinook salmon sport fishery, allowing easily comparable information to be obtained on a more regular basis and thus providing a more useful method for monitoring changes in the fishery. In addition to the data collected by the statewide freshwater guided sport fishing reporting program, periodic

surveys of the Nushagak River Chinook salmon fishery should be continued to ensure effective management of this important sport fishery. With a current and thorough understanding of this fishery and its participants, ADF&G will be more prepared to face continued management challenges in this dynamic sport fishery.

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## REFERENCES CITED

- Cappiello, T., and J. E. Dye. 2006. Survey of the Chinook salmon sport fishery in the lower Nushagak River, Alaska, 2001. Alaska Department of Fish and Game, Fishery Data Series No. 06-68, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/fds06-68.pdf>
- DiCostanzo, D. J. 1956. Creel census techniques and harvest of fishes in Clear Lake, Iowa. Iowa State College, Ph.D. dissertation, Ames, Iowa.
- Dunaway, D. O., and A. E. Bingham. 1992. Creel surveys on the Chinook salmon sport fishery on the lower Nushagak River and Mid-Mulchatna River, Alaska, 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-16, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/fds92-16.pdf>
- Dunaway, D. O., and S. J. Fleischman. 1995. Surveys of the Chinook and coho salmon sport fisheries in the Nushagak and Mulchatna rivers, Alaska 1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-18, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/fds95-18.pdf>
- Dunaway, D. O., G. P. Naughton, and M. J. Jaenicke. 2000. Area management report for the recreational fisheries of the Southwest Alaska Sport Fish Management Area, 1998. Alaska Department of Fish and Game, Fishery Management Report No. 00-03, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/fmr00-03.pdf>
- Dye, J. E. 2005. Survey of the Chinook salmon sport fishery in the lower Nushagak River, Alaska, 2000. Alaska Department of Fish and Game, Fishery Data Series No. 05-23, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/fds05-23.pdf>
- Efron, B., and R. J. Tibshirani. 1993. An introduction to the bootstrap. 1st edition. Chapman and Hall, New York, NY
- Gryska, A. D., and G. P. Naughton. 2001. Surveys of the Chinook and coho salmon sport fisheries in the lower Naknek River, Alaska, 1999. Alaska Department of Fish and Game, Fishery Data Series No. 01-01, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/fds01-01.pdf>
- 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. <http://www.adfg.alaska.gov/FedAidPDFs/fds96-32.pdf>
- Howe, A. L., G. Fidler, and M. J. Mills. 1995. Harvest, catch, and participation in Alaska sport fisheries during 1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-24, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/fds95-24.pdf>
- 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 No. 97-29 (revised), Anchorage. [http://www.adfg.alaska.gov/FedAidPDFs/fds97-29\(revised\).pdf](http://www.adfg.alaska.gov/FedAidPDFs/fds97-29(revised).pdf)
- 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 No. 98-25 (revised), Anchorage. [http://www.adfg.alaska.gov/FedAidPDFs/fds98-25\(revised\).pdf](http://www.adfg.alaska.gov/FedAidPDFs/fds98-25(revised).pdf)
- 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 No. 99-41 (revised), Anchorage. [http://www.adfg.alaska.gov/FedAidPDFs/fds99-41\(revised\).pdf](http://www.adfg.alaska.gov/FedAidPDFs/fds99-41(revised).pdf)
- Howe, A. L., R. J. Walker, C. Olnes, K. Sundet, and A. E. Bingham. 2001d. Participation, catch, and harvest in Alaska sport fisheries during 1999. Alaska Department of Fish and Game, Fishery Data Series No. 01-08, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/fds01-08.pdf>
- Jearld, A., Jr. 1983. Age determination. Pages 301-324 *in* L. A. Nielsen, editors. Fisheries techniques. The American Fisheries Society, Bethesda, Maryland.
- Jennings, G. B., K. Sundet, and A. E. Bingham. 2007. Participation, catch, and harvest in Alaska sport fisheries during 2004. Alaska Department of Fish and Game, Fishery Data Series No. 07-40, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/fds07-40.pdf>

## REFERENCES CITED (Continued)

- Jennings, G. B., K. Sundet, and A. E. Bingham. 2009a. Estimates of participation, catch, and harvest in Alaska sport fisheries during 2005. Alaska Department of Fish and Game, Fishery Data Series No. 09-47, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/FDS09-47.pdf>
- Jennings, G. B., K. Sundet, and A. E. Bingham. 2009b. Estimates of participation, catch, and harvest in Alaska sport fisheries during 2006. Alaska Department of Fish and Game, Fishery Data Series No. 09-54, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/FDS09-54.pdf>
- Jennings, G. B., K. Sundet, and A. E. Bingham. 2010. Estimates of participation, catch, and harvest in Alaska sport fisheries during 2007. Alaska Department of Fish and Game, Fishery Data Series No. 10-02, Anchorage. <http://www.adfg.alaska.gov/FedAidpdfs/Fds10-02.pdf>
- Jennings, G. B., K. Sundet, A. E. Bingham, and D. Sigurdsson. 2004. Participation, catch, and harvest in Alaska sport fisheries during 2001. Alaska Department of Fish and Game, Fishery Data Series No. 04-11, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/fds04-11.pdf>
- Jennings, G. B., K. Sundet, A. E. Bingham, and D. Sigurdsson. 2006a. Participation, catch, and harvest in Alaska sport fisheries during 2002. Alaska Department of Fish and Game, Fishery Data Series No. 06-34, Anchorage. <http://www.adfg.alaska.gov/FedAidpdfs/fds06-34.pdf>
- Jennings, G. B., K. Sundet, A. E. Bingham, and D. Sigurdsson. 2006b. Participation, catch, and harvest in Alaska sport fisheries during 2003. Alaska Department of Fish and Game, Fishery Data Series No. 06-44, Anchorage. <http://www.adfg.alaska.gov/FedAidpdfs/fds06-44.pdf>
- Jones, M., T. Sands, S. Morstad, P. Salomone, T. Baker, G. Buck, and F. West. 2009. 2008 Bristol Bay area annual management report. Alaska Department of Fish and Game, Fishery Management Report No. 09-30, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/FMR09-30.pdf>
- Marsh, L. E. 2000. Angler effort and harvest of Chinook salmon by the recreational fisheries in the lower Kenai River, 1998. Alaska Department of Fish and Game, Fishery Data Series No. 00-21, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/fds00-21.pdf>
- Mills, M. J. 1979. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report 1978-1979, Project F-9-11(20)SW-I-A, Juneau. [http://www.adfg.alaska.gov/FedAidPDFs/FREDF-9-11\(20\)SW-I-A.pdf](http://www.adfg.alaska.gov/FedAidPDFs/FREDF-9-11(20)SW-I-A.pdf)
- Mills, M. J. 1980. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1979-1980, Project F-9-12(21) SW-I-A, Juneau. [http://www.adfg.alaska.gov/FedAidPDFs/FREDF-9-12\(21\)SW-I-A.pdf](http://www.adfg.alaska.gov/FedAidPDFs/FREDF-9-12(21)SW-I-A.pdf)
- Mills, M. J. 1981a. Alaska statewide sport fish harvest studies. 1979 data. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report 1980-1981, Project F-9-13(22a)SW-I-A, Juneau. [http://www.adfg.alaska.gov/FedAidPDFs/FREDF-9-13\(22a\)SW-I-A.pdf](http://www.adfg.alaska.gov/FedAidPDFs/FREDF-9-13(22a)SW-I-A.pdf)
- Mills, M. J. 1981b. Alaska statewide sport fish harvest studies. 1980 data. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report 1980-1981, Project F-9-13(22b)SW-I-A, Juneau. [http://www.adfg.alaska.gov/FedAidPDFs/FREDF-9-13\(22b\)SW-I-A.pdf](http://www.adfg.alaska.gov/FedAidPDFs/FREDF-9-13(22b)SW-I-A.pdf)
- Mills, M. J. 1982. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report 1981-1982, Project F-9-14(23)SW-I-A, Juneau. [http://www.adfg.alaska.gov/FedAidPDFs/FREDF-9-14\(23\)SW-I-A.pdf](http://www.adfg.alaska.gov/FedAidPDFs/FREDF-9-14(23)SW-I-A.pdf)
- Mills, M. J. 1983. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report 1982-1983, Project F-9-15(24)SW-I-A, Juneau. [http://www.adfg.alaska.gov/FedAidPDFs/FREDF-9-15\(24\)SW-I-A.pdf](http://www.adfg.alaska.gov/FedAidPDFs/FREDF-9-15(24)SW-I-A.pdf)
- Mills, M. J. 1984. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report 1983-1984, Project F-9-16(25)SW-I-A, Juneau. [http://www.adfg.alaska.gov/FedAidPDFs/FREDF-9-16\(25\)SW-I-A.pdf](http://www.adfg.alaska.gov/FedAidPDFs/FREDF-9-16(25)SW-I-A.pdf)

## REFERENCES CITED (Continued)

- Mills, M. J. 1985. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report 1984-1985, Project F-9-17(26)SW-I-A, Juneau. [http://www.adfg.alaska.gov/FedAidPDFs/FREDF-9-17\(26\)SW-I-A.pdf](http://www.adfg.alaska.gov/FedAidPDFs/FREDF-9-17(26)SW-I-A.pdf)
- Mills, M. J. 1986. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report 1985-1986, Project F-10-1(27)RT-2, Juneau. [http://www.adfg.alaska.gov/FedAidPDFs/FREDF-10-1\(27\)RT-2.pdf](http://www.adfg.alaska.gov/FedAidPDFs/FREDF-10-1(27)RT-2.pdf)
- Mills, M. J. 1987. Alaska statewide sport fisheries harvest report, 1986. Alaska Department of Fish and Game, Fishery Data Series No. 2, Juneau. <http://www.adfg.alaska.gov/FedAidPDFs/fds-002.pdf>
- Mills, M. J. 1988. Alaska statewide sport fisheries harvest report, 1987. Alaska Department of Fish and Game, Fishery Data Series No. 52, Juneau. <http://www.adfg.alaska.gov/FedAidPDFs/fds-052.pdf>
- Mills, M. J. 1989. Alaska statewide sport fisheries harvest report, 1988. Alaska Department of Fish and Game, Fishery Data Series No. 122, Juneau. <http://www.adfg.alaska.gov/FedAidPDFs/fds-122.pdf>
- 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. <http://www.adfg.alaska.gov/FedAidPDFs/fds90-44.pdf>
- 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. <http://www.adfg.alaska.gov/FedAidPDFs/fds91-58.pdf>
- 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. <http://www.adfg.alaska.gov/FedAidPDFs/fds92-40.pdf>
- 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. <http://www.adfg.alaska.gov/FedAidPDFs/fds93-42.pdf>
- 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. <http://www.adfg.alaska.gov/FedAidPDFs/fds94-28.pdf>
- Minard, R. E. 1987. Effort and catch statistics for the Chinook salmon (*Oncorhynchus tshawytscha*) sport fishery in the lower Nushagak River, 1986. Alaska Department of Fish and Game, Fishery Data Series No. 15, Juneau. <http://www.adfg.alaska.gov/FedAidPDFs/fds-015.pdf>
- Minard, R. E., and T. E. Brookover III. 1988. Effort and catch statistics for the sport fishery for Chinook in the lower Nushagak River, 1987. Alaska Department of Fish and Game, Fishery Data Series No. 43, Juneau. <http://www.adfg.alaska.gov/FedAidPDFs/fds-043.pdf>
- Minard, R. E., and D. O. Dunaway. 1995. 1994 Area management report for the recreational fisheries of the southwest Alaska sport fish management area. Alaska Department of Fish and Game, Fishery Management Report No. 95-02, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/fmr95-02.pdf>
- Minard, R. E., D. O. Dunaway, and M. J. Jaenicke. 1998. Area management report for the recreational fisheries of the Southwest Alaska Sport Fish Management Area, 1997. Alaska Department of Fish and Game, Fishery Management Report No. 98-3, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/fmr98-03.pdf>
- Minard, R. E., and S. P. Morstad. 1985. Nushagak River Chinook salmon (*O. tshawytscha*) sport fish monitoring program, 1982 and 1984. Alaska Department of Fish and Game, Bristol Bay Data Report No. 85-7, Dillingham. <http://www.adfg.alaska.gov/FedAidpdfs/BBDR.1985.07.pdf>
- Sands, T., C. Westing, P. Salomone, S. Morstad, T. Baker, F. West, and C. Brazil. 2008. 2007 Bristol Bay area annual management report. Alaska Department of Fish and Game, Fishery Management Report No. 08-28, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/fmr08-28.pdf>

## REFERENCES CITED (Continued)

- Sigurdsson, D., and B. Powers. 2009. Participation, effort, and harvest in the sport fish business/guide licensing and logbook reporting programs, 2006-2008. Alaska Department of Fish and Game, Special Publication No. 09-11, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/SP09-11.pdf>
- Sokal, R. R., and F. J. Rohlf. 1981. Biometry. 2nd edition. W. H. Freeman and Company, New York.
- Thompson, S. K. 2002. Sampling. 2nd edition. John Wiley and Sons, New York.
- Walker, R. J., C. Olnes, K. Sundet, A. L. Howe, and A. E. Bingham. 2003. Participation, catch, and harvest in Alaska sport fisheries during 2000. Alaska Department of Fish and Game, Fishery Data Series No. 03-05, Anchorage. <http://www.adfg.alaska.gov/FedAidPDFs/fds03-05.pdf>
- Welander, A. D. 1940. A study of the development of the scale of Chinook salmon *Oncorhynchus tshawytscha*. Master's thesis. University of Washington, Seattle.





**APPENDIX A: NUSHAGAK-MULCHATNA KING SALMON  
MANAGEMENT PLAN**

## Appendix A1.–Nushagak-Mulchatna King Salmon Management Plan.

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### 5 AAC 06.361. NUSHAGAK-MULCHATNA KING SALMON MANAGEMENT PLAN.

- (a) The purpose of this management plan is to ensure biological spawning escapement requirements of King salmon into the Nushagak-Mulchatna river systems. It is the intent of the Alaska Board of Fisheries (board) that Nushagak-Mulchatna King 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 King salmon stocks in a conservative manner consistent with sustained yield principles and the subsistence priority.
- (b) The department shall manage the commercial and sport fisheries in the Nushagak District as follows:
- (1) to achieve an inriver goal of 75,000 King 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 King salmon; and
    - (C) a King salmon sport fishery guideline harvest level of 5,000 fish 20 inches or more in length;
  - (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 King 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 King 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 King 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 King salmon in the Nushagak River is less than 75,000 fish, and to ensure that the guideline harvest is not exceeded, a daily bag limit of 1 fish per day, 1 in possession for King salmon 20 inches or more in length is applied to the sport fishery;
  - (3) if the projected inriver return of King salmon in the Nushagak River is less than 55,000 fish, and to ensure that the projected spawning escapement does not fall below 40,000 fish, shall establish, by emergency order, fishing periods to restrict the King 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 King salmon; if a non-retention fishery for King salmon is established under this paragraph, the use of bait will be prohibited until the end of the King 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 King salmon sport fishery
- (e) If the spawning escapement of King 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 King salmon; and
  - (3) shall establish, by emergency order, fishing periods during which the time or area is reduced for the inriver King salmon subsistence fishery in the Nushagak River.