

**Fishery Data Series No. 05-06**

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**Situk River Chinook and Sockeye Salmon Sport  
Harvest Estimates, 2000, 2001, 2002, and 2003**

by

**Robert E. Johnson**

February 2005

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Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries





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## ABSTRACT

Angler effort and harvests of Chinook salmon *Oncorhynchus tshawytscha* and sockeye salmon *Oncorhynchus nerka* were estimated at Situk River from 5 June to 28 July, 2000, from 4 June to 27 July, 2001, 3 June to 26 July, 2002, and from 3 June to 26 July, 2003. In 2000, an estimated 20,772 (SE = 1,694) angler-hours were expended to harvest a total of 1,014 (SE = 133) large Chinook salmon 28 inches (71 cm) or more in total length (TL), 162 (SE = 29) small Chinook salmon (<28 inches TL), and 4,038 (SE = 413) sockeye salmon. In 2001, an estimated 17,978 (SE = 1,297) angler-hours were expended to harvest a total of 75 (SE = 23) large Chinook salmon 28 inches (71 cm) or greater TL, 6 (SE = 4) small Chinook salmon (<28 inches TL), and 6,270 (SE = 616) sockeye salmon. In 2002, an estimated 15,668 (SE = 1,449) angler-hours were expended to harvest a total of 57 (SE = 15) large Chinook salmon 28 inches (71 cm) or greater TL, 42 (SE = 14) small Chinook salmon (28>TL≥16 inches TL), 30 (SE = 10) jack Chinook salmon (<16 inches TL), and 9,465 (SE = 1,100) sockeye salmon. In 2003, an estimated 16,746 (SE = 1,239) angler-hours were expended to harvest a total of 840 (SE = 96) large Chinook salmon equal to or greater than 28 inches (71 cm) TL, 69 (SE = 10) small Chinook salmon (28>TL≥20 inches), 141 (SE = 32) jack Chinook salmon (<20 inches TL), and 7,842 (SE = 760) sockeye salmon. Most of the Chinook salmon sampled from the Situk River were aged 0.1, 0.2, or 0.3, and the age composition varied substantially among years.

Key words: Creel survey, angler effort and harvest, sport fishery, Chinook salmon, sockeye salmon, Situk River, Yakutat, Southeast Alaska.

## INTRODUCTION

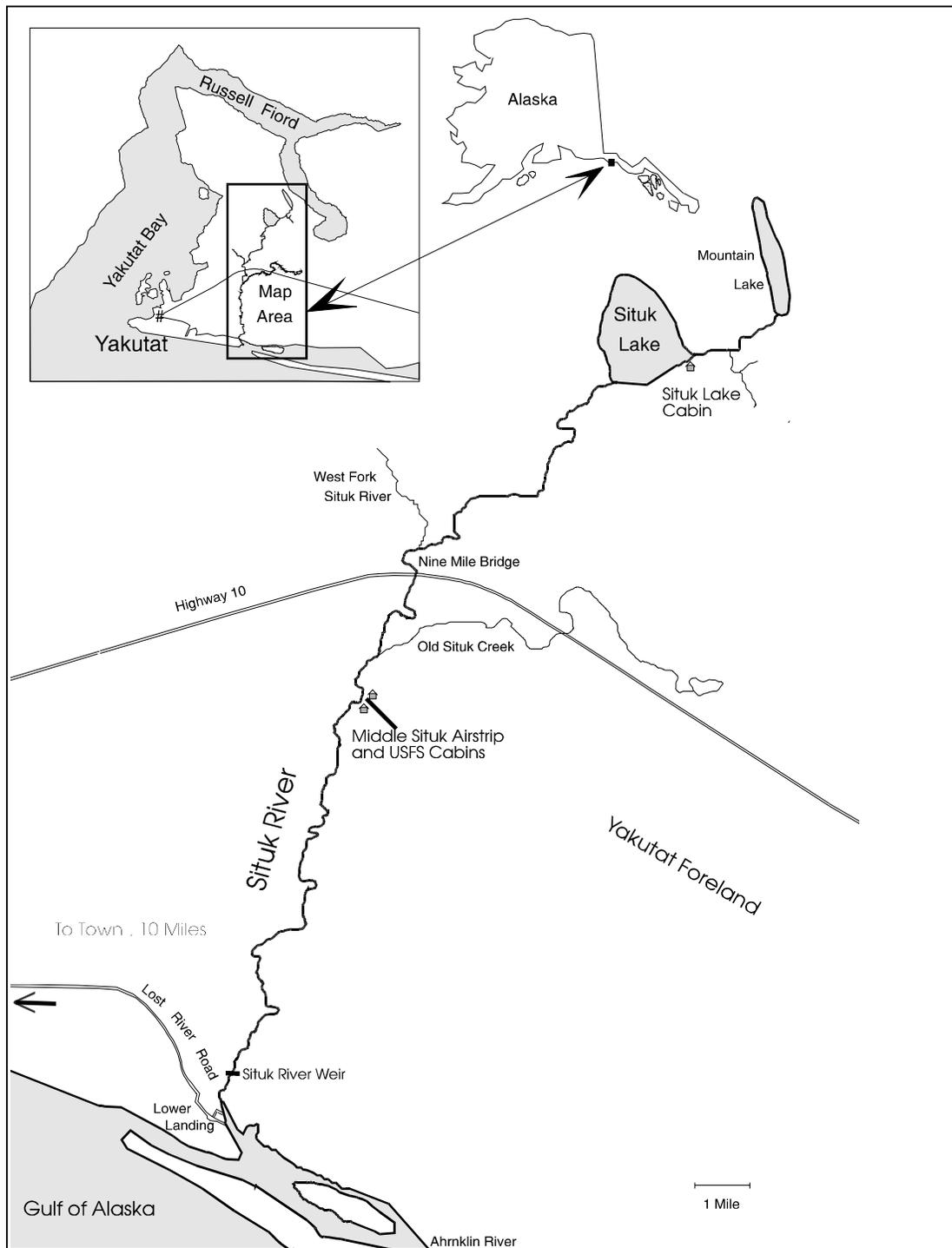
Sport fisheries in marine and fresh waters near Yakutat, Alaska offer outstanding fishing opportunities for both residents and tourists visiting the area. The Yakutat sport fishing area includes those areas drained by streams entering, and including the Gulf of Alaska between Cape Suckling and Cape Fairweather. Angler harvests for the Yakutat area are estimated through use of Statewide Harvest Survey (SWHS) questionnaires mailed annually to a sample of sport anglers who purchased sport fishing licenses in Alaska (Walker et al. 2003; Jennings et al. 2004, *In prep*).

The majority of freshwater angling effort for Chinook and sockeye salmon in the Yakutat area occurs within the Situk River, located approximately 10 miles east of Yakutat (Figure 1). The Situk River sport fishery targets Chinook and sockeye salmon from June through July. The estimated sport harvest of Situk River Chinook salmon increased from several hundred during the early 1980s to several thousand during the late 1990s (ADF&G unpublished data). Similarly, estimated sport harvests of Situk River sockeye salmon increased from 544 in 1986 to over 9,000

during 2002 (Mills 1987-1988a, b, 1989-94; Howe et al. 1995-96, 2001 a,b,c,d; Jennings et al. 2004, *In prep*; Walker et al. 2003).

Situk River Chinook salmon harvest and age data are useful for harvest management and cohort analyses. A Situk River Management Plan for Chinook salmon is dependent upon closely monitoring harvests inseason to ensure escapement goals (which are linked to counts at the weir). The creel survey at the primary exit location for anglers on the Situk River was conducted during June and July of 2000-2003 to document angler effort and harvest of Chinook and sockeye salmon above and below the Situk River weir.

One of the immediate needs for this process was the collection of information to describe current use patterns of Situk River anglers. Residency and transportation statistics were also gathered during the Situk River harvest survey to provide angler use data for assistance in development of the Situk River Cooperative Planning Strategy. This cooperative management strategy is being developed with the State of Alaska, City and Borough of Yakutat, Yakutat Tlingit Tribe, and the United States Forest Service (USFS) to address future management decisions affecting activities within the Situk River corridor.



**Figure 1.**—Map showing the Situk River drainage, the interview sites, and the access location.

## METHODS

### EFFORT, CATCH, AND HARVEST ESTIMATES

A two-stage survey was conducted 5 June to 28 July, 2000, 4 June to 27 July, 2001, 3 June to 26 July, 2002, and 3 June to 26 July, 2003 to estimate Situk River sport fishing effort and harvest of Chinook and sockeye salmon. Residency and transportation data were also collected at the time of interview and allowed for angler class-specific estimates of effort and harvest.

Chinook salmon were classified in the 2000 survey as either large,  $\geq 28$  inches TL, or small,  $< 28$  inches TL, to conform with regional size standards for adult (marine residence 3+ years) and jack Chinook salmon (marine residence 1-2 years). Harvests of adult Chinook salmon are of most importance for determining spawner-recruitment relationships. During the 2001, 2002, and 2003 surveys small fish were further split into those less than 20" (marine residence 1 year) and those between 20 and 28" (marine residence 2 years). Additionally, harvests of Chinook salmon were estimated by location (above and below a weir located about 1.5 miles upstream) so that escapements above the weir could be better estimated for stock-recruitment analysis. One sampler was stationed at the Situk River Lower Landing (Figure 1) to interview anglers completing fishing trips. This is the primary exit point from the river for anglers floating downstream from the Nine-mile Bridge about 13.5 miles upstream, and many anglers also fish this area on foot or from boats launched here. Although there are several exit sites at the lower river, including a new trailhead located several hundred yards up the road from the river, the technician took great care to intercept and interview all exiting anglers. A few anglers also fish the river from two USFS cabins located upstream as well as near the Nine-mile Bridge.

Time of day (TOD) stratification was used during surveys in all years. In 1998, 3 TOD strata were used: early-day (0600 to 1200 hours), mid-day (1200 to 1800 hours), and late-day (1800 to 2400 hours). As a result, only 2 TOD

strata were used during 2000 through 2003 surveys: mid-day (1100 to 1730 hours) and late-day (1730 to 2400 hours). By adjusting the mid-day stratum to start an hour earlier, nearly all of the fishery could be monitored. Each of these TOD strata ("days") were sampled systematically. The late-day stratum was sampled one day in every three, and the mid-day stratum two days in every six. Due to personnel constraints, the sampling interval for the mid-day stratum was not always regular.

Estimates of angler effort, and catch and harvest of Chinook and sockeye salmon for each stratum were obtained by the procedures appropriate to a stratified two-stage sample survey with "days" as the first stage and anglers as the second stage. Equations are detailed in Appendix A7, or see Bernard et al. (1998 : Chapter 2).

### AGE COMPOSITION ESTIMATES

Four scales were sampled near the preferred area on each Chinook salmon, at a point on a diagonal line from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin, two rows above the lateral line (Welander 1940). If the scales in the preferred location could not be obtained, another set of scales was taken from as close to the preferred scale area as possible. However, scales were only taken from the preferred area bounded dorsally by the fourth row of scales above the lateral line, ventrally by the lateral line, and between a line from the posterior insertion of the dorsal fin to the posterior edge of the left ventral fin and a vertical line up the side of the fish starting at the anterior insertion of the anal fin. If no scales were available in the preferred area on the left side of the fish, scales were collected from the preferred area on the right side of the fish. Scales were then mounted on gum cards, and impressions made in cellulose acetates (Clutter and Whitesel 1956). The scales were then aged using procedures from Olsen (1995). Lengths in millimeters (mid-eye to fork of tail) of sampled Chinook salmon were also recorded, and sex was determined when possible.

Equations for estimates of age composition are detailed in Appendix A7.

## RESULTS

### EFFORT AND HARVEST

Effort for Chinook and sockeye salmon totaled 20,772 (SE = 1,694), 17,978 (SE= 1,297), 15,668 (SE=1,449), and 16,746 (SE= 1,239) angler-hours during 2000, 2001, 2002, and 2003, respectively (Tables 1 and 2). Angler-days of effort during these years ranged from 3,321 (SE=232) in 2001 to 3,828 (SE = 259) in 2000.

Class specific estimates of angler-days of effort and a breakdown of transportation used by

anglers finishing their fishing trips during 2000 through 2003 are presented in Tables 1 and 2. Additionally, estimates by transport category (unmotorized boats, motorized (non-jet) boats, jet outboard motor boats, and anglers accessing the river by foot) are presented therein. During 2000 through 2003, on average, non-residents accounted for 96% of the effort, and 20% of the anglers were guided. An average of 23% of angler-days occurred with the use of unmotorized boats, 11% from motorized (non-jet) boats, 10% from jet outboard motor boats, and 55% without a boat (access by foot).

**Table 1.**—Summary of estimated angler-hours and angler-days of effort by angler type or by transportation type at the Situk River Lower Landing fishery during 2000 and 2001.

Angler or Transportation Type	2000				2001			
	<u>Angler-hours</u>		<u>Angler-days</u>		<u>Angler-hours</u>		<u>Angler-days</u>	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
All anglers	20,772	1,694	3,828	259	17,978	1,297	3,321	232
Resident anglers	408	95	99	14	827	157	219	32
Non-resident anglers	20,364	1,692	3,729	259	17,152	1,272	3,102	224
Guided anglers	4,371	520	717	76	4,868	457	720	61
Unguided anglers	16,401	1,484	3,111	237	13,100	1,093	2,598	196
Jet boats	2,196	448	300	55	1,931	291	285	39
Non-jet motor boats	1,233	276	267	54	2,152	291	402	45
Unpowered boats	6,836	775	1,182	118	3,552	334	576	63
On foot	10,507	1,017	2,079	178	10,344	995	2,058	182

**Table 2.**— Summary of estimated angler-hours and angler-days of effort by angler type or by transportation type at the Situk River Lower Landing fishery during 2002 and 2003.

Angler or Transportation Type	2002				2003			
	Angler-hours		Angler-days		Angler-hours		Angler-days	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
All anglers	15,668	1,449	3,333	284	16,746	1,239	3,441	217
Resident anglers	758	110	216	23	498	86	162	24
Non-resident anglers	14,910	1,407	3,117	277	16,248	1,221	3,279	210
Guided anglers	3,956	393	726	61	3,788	347	648	55
Unguided anglers	11,712	1,200	2,607	255	12,959	1,107	2,793	199
Jet boats	1,656	274	288	41	1,509	261	270	46
Non-jet motor boats	1,988	252	453	50	2,504	292	459	50
Unpowered boats	2,709	239	531	40	3,668	346	723	77
On foot	9,315	1,118	2,061	239	9,144	912	1,959	173

An estimated 1,014 (SE = 133) large Chinook salmon at least 28 inches (71 cm) TL, and 4,038 (SE = 413) sockeye salmon were harvested from the Situk River during 2000 (Table 3). Of these, 705 (SE = 114) large Chinook and 972 (SE = 261) sockeye salmon were harvested above the Situk River weir. During 2001, 75 (SE = 23) large Chinook salmon at least 28 inches (71 cm) TL, and 6,270 (SE = 616) sockeye were harvested from the Situk River. Of these, 45 (SE = 16) large Chinook and 1,479 (SE = 181) sockeye were harvested above the Situk River weir.

During 2002, 57 (SE = 15) large Chinook salmon at least 28 inches (71 cm) TL, and 9,465 (SE = 1,100) sockeye were harvested from the Situk River. Of these, 24 (SE = 12) large Chinook and 1,434 (SE = 232) sockeye were harvested above the Situk River weir (Table 4). During 2003, 840 (SE = 96) large Chinook salmon at least 28 inches (71 cm) TL, and 7,842 (SE = 760) sockeye were harvested from the Situk River. Of these, 498 (SE = 68) large Chinook and 2,010 (SE = 272) sockeye were harvested above the Situk River weir (Table 4).

Catch and harvest estimates for large, small, and jack Chinook, and sockeye salmon and

associated standard errors by location, angler type, and transportation type are presented in Tables 3 and 4. Class specific estimates of harvest showed that non-residents accounted for 89% to 94% of the annual Chinook harvest and 94% to 97% of the annual sockeye salmon harvest at the Situk River during the 2000 – 2003 period (Tables 3 and 4).

Detailed sampling information, including angler counts and numbers of completed interviews for overall estimates by sampling period, is presented in Appendices A1, A2, A3, and A4 for 2000, 2001, 2002, and 2003, respectively.

### Chinook Salmon Age Data

Age 0.3 Chinook salmon were the dominant age class (56%) in the Chinook harvest in 2000, whereas 62% of the 2001 harvest were age 0.1. During 2002, age classes were spread across the 0.1, 0.2, and 0.3 age classes proportionally as 23%, 27%, and 29%, of the harvest, respectively. The 0.3 age class again dominated the harvest in 2003 (71% of the sampled harvest). Overall, 85% of the Chinook salmon harvested (Tables 5, 6, 7, and 8) emigrated from the Situk River as 0-age smolt.

**Table 3.**– Summary of estimated total catch and harvest of salmon by location, angler type and/or transportation type at the Situk River Lower Landing fishery during 2000 and 2001.

Location of harvest	Angler or Transportation Type	Salmon Species	2000				2001			
			Total catch		Harvest		Total catch		Harvest	
			Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Above and below weir	All anglers	All Chinook	1,431	192	1,176	152	564	107	405	93
	All anglers	Large Chinook <sup>a</sup>	1,200	167	1,014	133	126	28	75	23
	All anglers	Small Chinook <sup>b</sup>	231	34	162	29	9	4	6	4
	All anglers	Jack Chinook <sup>c</sup>	0	0	0	0	429	107	324	99
	All anglers	Sockeye	4,407	413	4,038	413	8,109	906	6,270	616
Above and below weir	Resident anglers	All Chinook	66	14	66	14	60	37	15	7
	Non-resident anglers	All Chinook	1,365	184	1,110	145	504	104	390	93
	Guided anglers	All Chinook	825	157	678	121	351	76	276	66
	Unguided anglers	All Chinook	606	85	498	71	213	56	129	48
	Anglers in jet boats	All Chinook	327	77	267	56	225	60	219	58
	Non-jet motor boats	All Chinook	72	23	54	18	9	6	9	6
	Unpowered boats	All Chinook	768	136	603	104	228	69	111	37
	Anglers on foot	All Chinook	264	51	252	50	102	26	66	23
	Resident anglers	Sockeye	105	40	105	40	519	159	333	68
	Non-resident anglers	Sockeye	4,302	408	3,933	408	7,590	827	5,937	590
	Guided anglers	Sockeye	765	144	705	142	3,000	460	2,076	264
	Unguided anglers	Sockeye	3,642	370	3,333	365	5,109	564	4,194	453
	Above weir	All anglers	Large Chinook <sup>a</sup>	846	143	705	114	75	22	45
All anglers		Small Chinook <sup>b</sup>	186	29	120	25	6	4	6	4
All anglers		Jack Chinook <sup>c</sup>	0	0	0	0	381	109	294	100
All anglers		Sockeye	1,152	296	972	261	2,148	375	1,479	181
Below weir	All anglers	Large Chinook <sup>a</sup>	354	78	309	69	51	10	30	9
	All anglers	Small Chinook <sup>b</sup>	45	12	42	12	3	2	0	0
	All anglers	Jack Chinook <sup>c</sup>	0	0	0	0	48	15	30	11
	All anglers	Sockeye	3,255	416	3,066	407	5,961	872	4,791	627

<sup>a</sup> Chinook salmon >28”.

<sup>b</sup> Chinook salmon <28” in 2000, Chinook salmon 20”-28” in 2001.

<sup>c</sup> Chinook salmon <20”.

**Table 4.**—Summary of estimated total catch and harvest of salmon by location, angler type and/or transportation type at the Situk River Lower Landing fishery during 2002 and 2003.

Location of harvest	Angler or Transportation Type	Salmon Species	2002				2003			
			Total catch		Harvest		Total catch		Harvest	
			Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Above and below weir	All anglers	All Chinook	360	71	129	34	1,404	185	1,050	119
	All anglers	Large Chinook <sup>a</sup>	165	31	57	15	975	106	840	96
	All anglers	Small Chinook <sup>b</sup>	120	27	42	14	69	10	69	10
	All anglers	Jack Chinook <sup>c</sup>	75	21	30	10	360	112	141	32
	All anglers	Sockeye	13,779	1,695	9,465	1,100	10,794	1,084	7,842	760
Above and below weir	Resident anglers	All Chinook	18	6	12	6	78	19	60	13
	Non-resident anglers	All Chinook	342	69	117	31	1,326	186	990	118
	Guided anglers	All Chinook	132	29	66	20	702	98	546	73
	Unguided anglers	All Chinook	228	68	63	24	702	162	504	91
	Anglers in jet boats	All Chinook	78	23	45	16	174	42	147	37
	Non-jet motor boats	All Chinook	33	9	24	9	126	30	93	21
	Unpowered boats	All Chinook	63	17	24	12	783	146	528	77
	Anglers on foot	All Chinook	186	66	36	13	312	71	273	68
	Resident anglers	Sockeye	660	91	459	57	336	67	195	47
	Non-resident anglers	Sockeye	13,119	1,649	9,006	1,067	10,458	1,072	7,647	758
	Guided anglers	Sockeye	3,807	439	2,511	289	2,550	262	1,806	210
	Unguided anglers	Sockeye	9,972	1,360	6,954	877	8,244	958	6,036	642
Above weir	All anglers	Large Chinook <sup>a</sup>	48	13	24	12	597	77	498	68
	All anglers	Small Chinook <sup>b</sup>	33	13	24	14	30	9	30	9
	All anglers	Jack Chinook <sup>c</sup>	33	11	18	7	276	100	108	27
	All anglers	Sockeye	2,274	380	1,434	232	2,997	360	2,010	272
Below weir	All anglers	Large Chinook <sup>a</sup>	117	30	33	10	378	54	342	51
	All anglers	Small Chinook <sup>b</sup>	87	25	18	6	39	11	39	11
	All anglers	Jack Chinook <sup>c</sup>	42	17	12	7	84	28	33	10
	All anglers	Sockeye	11,505	1,513	8,031	1,001	7,797	903	5,832	608

<sup>a</sup> Chinook salmon > 28"

<sup>b</sup> Chinook salmon 20" - 28"

<sup>c</sup> Chinook salmon < 20"

**Table 5.**—Estimated age, sex, and length composition of Chinook salmon taken in the Situk River sport fishery, 2000.

Sex <sup>a</sup>		Brood Year and Age Class								Total	R <sup>b</sup>
		1998	1997	1996	1995	1997	1996	1995	1994		
Females	N			54	11			13	2	80	42
	%			67.5	13.8			16.3	2.5	45.7	
	SE of %			5.3	3.9			4.2	1.8	3.8	
	Avg length			798	830			784	870	804	
	SD of avg length			41	69			43	42	45	
	SE of avg length			6	21			12	30	5	
	Harvest	0	0	363	74	0	0	87	13	538	
	SE of Harvest			56	11			13	2	82	
Males	N	26	16	42	3	1	2	4	1	95	54
	%	27.4	16.8	44.2	3.2	1.1	2.1	4.2	1.1	54.3	
	SE of %	4.6	3.9	5.1	1.8	1.1	1.5	2.1	1.1	3.8	
	Avg length	343	599	790	843	330	700	803	840	640	
	SD of avg length	72	75	43	32		57	33		203	
	SE of avg length	14	19	7	19		40	17		21	
	Harvest	175	108	282	20	7	13	27	7	638	
	SE of Harvest	26	16	41	3	1	2	4	1	94	
Sexes	N	32	18	139	21	1	4	27	6	248	130
Combined	%	12.9	7.3	56.0	8.5	0.4	1.6	10.9	2.4	100.0	
	SE of %	2.1	1.7	3.2	1.8	0.4	0.8	2.0	1.0	0.0	
	Avg length	344	613	794	837	330	700	789	843	726	
	SD of avg length	73	82	40	57		59	44	29	165	
	SE of avg length	13	19	3	12		29	9	12	10	
	Harvest	152	85	659	100	5	19	128	28	1,176	
	SE of Harvest	32	22	93	24	5	10	28	12	152	

<sup>a</sup> 175 of 248 aged fish were sexed.

<sup>b</sup> Scale samples from 97 Chinook salmon were regenerated (R) and scales from an additional 33 scales were unreadable.

**Table 6.**—Estimated age and length composition of Chinook salmon taken in the Situk River sport fishery, 2001.

Sex <sup>a</sup>		Brood Year and Age Class								Total	R <sup>b</sup>
		1999 0.1	1998 0.2	1997 0.3	1996 0.4	1998 1.1	1997 1.2	1996 1.3	1995 1.4		
Sexes Combined	N	55	2	7	21	2	0	2	0	89	20
	%	61.8	2.2	7.9	23.6	2.2	0	2.2	0.0	100.0	
	SE of %	5.2	1.6	2.9	4.5	1.6	0	1.6	0.0	0.0	
	Avg length	344	609	778	850	407		793		513	
	SD of avg length	36	141	24	39	2		74		228	
	SE of avg length	5	100	9	9	2		53		24	
	Harvest	250	9	32	96	9	0	9	0	405	
	SE of Harvest	61	7	13	28	7		7		93	

<sup>a</sup> Sex was not determined for samples taken in 2001.

<sup>b</sup> Scale samples from 20 Chinook salmon were regenerated (R).

**Table 7.**—Estimated age, sex, and length composition of Chinook salmon taken in the Situk River sport fishery, 2002.

Sex		Brood Year and Age Class								Total	R <sup>a</sup>	
		2000 0.1	1999 0.2	1998 0.3	1997 0.4	1999 1.1	1998 1.2	1997 1.3	1996 1.4			
Female	N	0	5	10	2	0	2	0	0	19	4	
	%		26.3	52.6	10.5		10.5			54.3		
	SE of %		10.4	11.8	7.2		7.2			8.5		
	Avg length		641	799	823		688			747		740
	SD of avg length		36	27	11		194			96		128
	SE of avg length		16	9	8		138			22		64
	Harvest		18	37	7	0	7	0	0	70		
	SE of Harvest		6	11	2		4			21		
Male	N	8	8	0	0	0	0	0	0	16	2	
	%	50.0	50.0							45.7		
	SE of %	12.9	12.9							8.5		
	Avg length	388	625							499		435
	SD of avg length	37	57							126		78
	SE of avg length	13	20							32		55
	Harvest	29	29	0	0	0	0	0	0	59		
	SE of Harvest	9	9							19		
Sexes Combined	N	8	13	10	2	0	2	0	0	35	6	
	%	22.9	37.1	28.6	5.7		5.7			100.0		
	SE of %	7.2	8.3	7.7	4.0		4.0					
	Avg length	388	631	799	823		688			638		
	SD of avg length	37	49	27	11		194			165		
	SE of avg length	13	13	9	8		138			28		
	Harvest	29	48	37	7	0	7	0	0	129		
	SE of Harvest	12	16	14	5		5			34		

<sup>a</sup> Scale samples from 6 Chinook salmon were regenerated (R).

**Table 8.**—Estimated age, sex, and length composition of Chinook salmon taken in the Situk River sport fishery, 2003.

Sex		Brood Year and Age Class								Total	R <sup>a</sup>
		2001 0.1	2000 0.2	1999 0.3	1998 0.4	2000 1.1	1999 1.2	1998 1.3	1997 1.4		
Female	N	0	2	94	5	0	3	8	3	115	808
	%		1.7	81.7	4.3		2.6	7.0	2.6	47.7	
	SE of %		1.2	3.6	1.9		1.5	2.4	1.5	3.2	
	Avg length		615	795	865		672	794	873	796	
	SD of avg length		92	37	26		10	31	71	51	
	SE of avg length		65	4	12		6	11	41	5	
	Harvest	0	9	410	22	0	13	35	13	501	
	SE of Harvest		2	54	3		2	5	2	66	
Male	N	21	15	77	1	2	2	7	1	126	669
	%	16.7	11.9	61.1	0.8	1.6	1.6	5.6	0.8	52.3	
	SE of %	3.3	2.9	4.4	0.8	1.1	1.1	2.0	0.8	3.2	
	Avg length	365	573	790	910	325	623	797	890	684	
	SD of avg length	45	72	47	0	21	103	37		178	
	SE of avg length	10	18	5	0	15	73	14		16	
	Harvest	91	65	335	4	9	9	30	4	549	
	SE of Harvest	12	9	43	1	2	2	4	1	71	
Sexes Combined	N	21	17	171	6	2	5	15	4	241	38
	%	8.7	7.1	71.0	2.5	0.8	2.1	6.2	1.7	100.0	
Combined	SE of %	1.8	1.7	2.9	1.0	0.6	0.9	1.6	0.8	0.0	
	Avg length	365	578	792	873	325	652	796	878	740	
	SD of avg length	45	72	42	30	21	58	33	58	142	
	SE of avg length	10	18	3	12	15	26	8	29	9	
	Harvest	91	74	745	26	9	22	65	17	1,050	
	SE of Harvest	22	19	90	11	6	10	18	9	119	

<sup>a</sup> Scale samples from 38 Chinook salmon were regenerated (R).

## DATA FILES

Appendix A5 contains a listing of the archived final data sets used during the analysis.

## DISCUSSION

### INSEASON MANAGEMENT ACTIONS AFFECTING EFFORT AND HARVEST

Situk River Chinook Salmon are managed according to the Situk-Ahrnklin Inlet and Lost River Chinook Salmon Fishery Management Plan which was adopted in 1991, with minor modifications by the Alaska Board of Fish during 1994, and most recently, 2003. (Appendix A6). The Situk River is currently managed for a

Chinook salmon escapement of 450 to 1,050 large fish with a mid-point of 730 large Chinook

salmon as the goal. Analysis shows returns are highest when escapements are between 450 and 1,050 large spawners and that returns are lower when escapements are above or below that range. The plan provides specific direction to managers based on projected abundance of large Situk River Chinook salmon.

Managers projected that the 2000 Situk River Chinook salmon escapement would exceed 750 large Chinook salmon, with the 2000 total run of large Chinook salmon expected to exceed 4,000 large Chinook. Prior to recent changes in the management plan, Alaska Administrative Code 5AAC 75.003 authorized the department to

liberalize sport fish bag and possession limits when the total escapement of a species listed in a management plan that has been adopted by the Board of Fisheries is projected to exceed the upper limit of the escapement goal range.

Accordingly, an Emergency Order was issued 7 June, 2000, increasing the daily bag limit for Chinook salmon on the Situk River to 2 Chinook salmon, 20 inches or more TL per day and in possession with an additional 10 Chinook less than 20 inches TL. Additionally, the non-resident annual limit for Chinook salmon 28 inches or more TL, was 2 fish. As of June 20, 2000, 677 large Chinook salmon had migrated past the Situk River weir. Fishery managers continued to project that the 2000 Situk River Chinook salmon escapement would greatly exceed 750 large fish. Therefore, in order to harvest the Chinook salmon surplus above and beyond the escapement goal while providing protection for upstream resident rainbow trout stocks, bait was allowed in the Situk River downstream of the Middle Situk Airstrip beginning on 22 June and extending until 15 August. Escapement of large Chinook salmon totaled 2,518 fish in 2000.

The sockeye salmon escapement projection for the season by 22 July, 2000 was 40,000 fish, which was within the escapement goal range but below the point goal. As a result, the bag and possession limits for sockeye salmon in the Situk River were reduced to two fish per day and two fish in possession. By 29 July, the harvest reductions in both the sport and commercial fisheries had allowed additional sockeye salmon to pass the Situk River weir, and the sockeye escapement goal had been reached. As a result, sockeye salmon limits on the Situk River were increased to three fish per day and in possession for the remainder of the season.

In 2001, managers projected early in the season that the large Chinook escapement through the Situk River weir would be at least 750 salmon. Accordingly, the sport fishery opened on 6 June with a daily bag limit for Chinook greater than 20 inches TL of one fish per day, with a non-resident annual limit for Chinook salmon 28 inches or greater of 3 fish. However, as of July 5, 2001, only 302 large Chinook salmon had passed upstream through the Situk River weir. As a

result, the sport fishery was restricted to catch-and-release angling only, beginning 7 July and continuing until 19 July when the weir count reached 578 large Chinook salmon. At that time, managers projected the 2001 Situk River Chinook salmon escapement would fall close to the optimum escapement goal. Therefore, beginning 19 July, a bag limit of one Chinook salmon larger than 28 inches TL per day was allowed downstream of the downstream Situk River weir markers. Escapement of large Chinook salmon totaled 696 fish in 2001.

Regulations for sockeye salmon in the Situk River during 2001 were 6 fish per day, and 12 in possession with no in-season management changes.

The 2002 escapement projection for large Chinook salmon was not sufficient for retention in the sport fishery until 3 July 2002 when managers were confident that the 2002 Situk River Chinook salmon escapement level would fall between 600 and 1,000 large fish (3-ocean age or older). The sport fishery was restricted to catch and release until 2 July 2002 when one large Chinook was allowed per day downstream from the Situk River weir markers. On 8 July, the weir count was 731 large Chinook salmon and managers projected that optimal escapement would be attained; therefore, the area open to Chinook salmon harvest was extended upstream to the Situk River middle airstrip. The 2002 Situk River Escapement totaled 1,024 large Chinook salmon.

Regulations for sockeye salmon in the Situk River during 2002 were 6 fish per day, and 12 in possession with no in-season management changes.

During 2003, managers projected that even if projected numbers of returning large Chinook were at the low end of the forecast range, and given an expected exploitation rate of 60%, that at least 1,500 large Chinook salmon would escape past the Situk River weir. At this level, the Situk-Ahrnklin Inlet and Lost River Chinook Salmon Commercial Fishery Management Plan directs the department to manage fisheries to harvest large Situk River Chinook salmon in excess of the escapement goal range. For the sport fishery, the plan gives the department discretion to increase

bag and possession limits for large Chinook salmon, with no annual limit for nonresidents, and allow the use of bait. For the sport fishery, the plan specifically directs the department to provide for bag and possession limits of 10 Chinook salmon less than 20 inches in length and one Chinook salmon 20 inches in length or greater, and no annual limit.

As of 21 June, 536 large Chinook salmon had migrated past the Situk River weir which is approximately five times the number necessary for the mid-point projection of the escapement goal and 65% greater than the average count for this date. On average, only 20% of the large Chinook salmon escapement has entered the river by this date. Based on the observed emigration, managers now projected with greater confidence that the 2003 Situk River spawning escapement of large Chinook salmon would exceed 1,050 fish, still at a level where the Situk-Ahrnklin Inlet and Lost River Chinook Salmon Commercial Fishery Management Plan directs the department to manage fisheries to harvest large Situk River Chinook salmon in excess of the escapement goal range. As a result, the bag limit in the Situk River for Chinook salmon 20 inches or greater TL increased to two fish per day with four in possession downstream from the Situk River Nine Mile Bridge, with no annual limit for nonresidents on 24 June, 2003.

Additionally, in order to harvest the Chinook salmon surplus above and beyond the escapement goal, while providing protection for upstream resident rainbow trout *Oncorhynchus mykiss* stocks, bait was allowed downstream from the Middle Situk River Airstrip and the area opened to Chinook retention between Situk Nine Mile Bridge and the Middle Situk Airstrip was extended until 15 August instead of closing July 1. On July 9, 2,111 large Chinook salmon had migrated past the Situk River weir, which was approximately three times the mid-point of the escapement goal range.

Generally, about 60% of the large Chinook salmon escapement has entered the river by this date. Managers now projected that the 2003 Situk River spawning escapement of large Chinook salmon would exceed 3,000 fish. Accordingly, on 11 June, the bag limit in the Situk River for

Chinook salmon 20 inches or greater TL increased once more to three fish per day, with six in possession, downstream from the Situk River Nine Mile Bridge, with no annual limit for nonresidents. Additionally, bait continued to be allowed downstream from the Middle Situk River Airstrip and the area between Situk Nine Mile Bridge and the Middle Situk Airstrip remained open for retention of Chinook salmon until August 15 instead of closing July 1. The Situk River escapement of large Chinook salmon totaled 2,615 fish during 2003.

Regulations for sockeye salmon in the Situk River during 2003 were 6 fish per day, and 12 in possession with no in-season management changes.

Harvests of both Chinook salmon and sockeye salmon at the Lower Landing as estimated from the creel survey were considerably higher than a comparable on-site creel survey conducted in 1988 (Suchanek and Bingham 1989), when 1,202 angler-days and 4,468 angler-hours were spent during roughly the same time period to catch 135 Chinook salmon. However, during the four years of surveys covered in this report, angling effort at the Situk was highest in 2000 and subsequently lower in the more recent years. While the reasons for the declining numbers of anglers participating in the Situk River Chinook and sockeye sport fishery is unknown, the general down-turn in the economy in 2000 and the events of September 11, 2001 probably played a role. In-season management actions based on projected reduced Chinook abundance during 2001 and 2002, and sockeye abundance during 2000 also possibly contributed to the slight reduction in effort.

Since the creel survey did not include harvests taken at the Nine-mile Bridge or at two USFS cabins, the creel survey estimates must be viewed as conservative. In 2000 the USFS conducted a survey at the Nine Mile Bridge during the peak of the fishery to estimate harvests of anglers exiting the river at that location. A total of 4,125 hours were expended to harvest 66 large Chinook salmon and 1,296 sockeye. Thus, our creel survey estimates for the Lower Landing slightly underestimated (6%) Chinook salmon harvest for the river and significantly

underestimated (25%) the sockeye salmon harvest that year. Given this level of sockeye salmon harvest going unsampled, our creel survey program serves best as an in-season, harvest index. The final post-season sockeye salmon sport harvests are obtained from the Statewide Harvest Survey (Walker, et al, 2000, Jennings et al, 2001, 2002).

Few Chinook salmon sampled from the Situk River were sexed due to the inability of the technician to determine sex of generally ocean-bright Chinook salmon with any certainty. Thus, the combined Situk sample for each year gives the most useful indication of age class composition for each year. The 1-ocean, and 4-ocean age classes are probably not represented proportionally in the harvest statistics due to low retention rates for the small jacks (1-ocean), and the general inability of anglers to land the largest (4-ocean) Chinook salmon in such a small stream.

## **CONCLUSIONS AND RECOMMENDATIONS**

The creel survey of Situk River Chinook and sockeye salmon harvests should be continued to document increasing sport harvest of Situk River Chinook and sockeye salmon in-season. This survey allows management of the Situk River under terms of the Situk River Chinook Management Plan, which also addresses management of the Situk River sockeye stock. Age composition data gathered also allows better analysis of stock-recruit relationships. Effort and harvest occurring near the Nine Mile Bridge and Situk River Middle Cabins should be monitored in future seasons to determine if current use-level assumptions are correct.

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## **APPENDIX A**

**Appendix A1.**—Summary of creel survey sampling results by interview period and date at the Lower Landing access location on the Situk River, 2000.

Date	Interview period <sup>a</sup>	Anglers observed	Anglers interviewed	Reported Chinook <sup>b</sup> catch	Observed Chinook <sup>b</sup> harvest	Reported hours of effort
06/05/00	1	1	1	0	0	1
06/06/00	2	4	4	0	0	24
06/07/00	1	6	6	0	0	24
06/08/00	1	18	18	0	0	60
06/09/00	2	6	6	0	0	18
06/12/00	1	13	13	1	1	105
06/13/00	2	6	6	1	1	53
06/16/00	1	37	37	6	6	167
06/17/00	2	30	30	7	7	134
06/18/00	2	28	28	9	8	95
06/19/00	2	51	51	16	16	303
06/20/00	1	42	42	2	2	223
06/23/00	1	84	84	17	15	424
06/24/00	2	56	56	11	11	253
06/25/00	2	45	45	28	12	209
06/26/00	1	79	79	11	11	430
06/29/00	1	84	84	18	17	471
06/30/00	2	39	39	10	10	184
07/01/00	2	31	31	13	11	158
07/02/00	1	74	74	26	22	564
07/05/00	1	53	53	11	11	305
07/06/00	2	66	66	22	17	381
07/07/00	2	58	58	32	32	334
07/08/00	1	80	80	18	17	622
07/11/00	1	37	37	5	4	194
07/12/00	2	50	50	37	31	237
07/13/00	2	42	42	40	33	191
07/14/00	1	39	39	8	6	182
07/17/00	1	38	38	33	22	246
07/18/00	2	14	14	2	2	58
07/19/00	2	22	22	4	4	73
07/20/00	1	7	7	2	2	27
07/23/00	1	14	14	9	7	77
07/25/00	2	5	5	0	0	21
07/26/00	1	13	13	0	0	58
07/27/00	2	6	6	1	0	35
<b>Total</b>		1,278	1,278	400	338	6,934

<sup>a</sup> 1 = Mid-day (1200 to 1800), 2 = Late-day (1800 to 2400).

<sup>b</sup> Chinook salmon of all sizes.

**Appendix A2.**—Summary of creel survey sampling results by interview period and date at the Lower Landing access location on the Situk River, 2001.

Date	Interview period <sup>a</sup>	Anglers observed	Anglers interviewed	Reported Chinook <sup>b</sup> catch	Observed Chinook <sup>b</sup> harvest	Reported hours of effort
06/06/01	3	39	39	0	0	188
06/07/01	2	18	18	0	0	89
06/08/01	2	24	24	0	0	136
06/09/01	3	3	3	0	0	9
06/12/01	3	14	14	0	0	60
06/13/01	2	19	19	0	0	115
06/14/01	2	25	25	1	1	113
06/15/01	3	39	39	3	3	241
06/18/01	3	48	48	2	1	245
06/19/01	2	28	28	0	0	135
06/20/01	2	33	33	3	3	132
06/21/01	3	49	49	1	1	321
06/24/01	3	76	76	2	1	428
06/25/01	2	73	73	1	0	345
06/26/01	2	42	42	4	4	245
06/27/01	3	49	49	0	0	268
06/30/01	3	56	56	12	7	367
07/01/01	2	48	48	5	3	286
07/02/01	2	56	56	6	4	324
07/03/01	3	69	69	4	3	420
07/06/01	3	31	31	15	15	168
07/07/01	2	39	39	17	0	202
07/08/01	2	28	28	4	1	113
07/09/01	3	35	35	45	44	181
07/12/01	3	34	34	24	21	193
07/13/01	2	27	27	15	0	109
07/14/01	2	16	16	20	19	91
07/15/01	3	18	18	1	1	110
07/18/01	3	21	21	0	0	112
07/19/01	2	8	8	0	0	60
07/20/01	2	12	12	0	0	35
07/21/01	3	7	7	3	3	44
07/24/01	3	13	13	0	0	53
07/25/01	2	5	5	0	0	22
07/26/01	2	4	4	0	0	22
07/27/01	3	2	2	0	0	16
<b>Total</b>		1,108	1,088	118	100	5,993

<sup>a</sup> 2 = Mid-day (1200 to 1800), 3 = Late-day (1800 to 2400).

<sup>b</sup> Chinook salmon of all sizes.

**Appendix A3.**—Summary of creel survey sampling results by interview period and date at the Lower Landing access location on the Situk River, 2002.

Date	Interview period <sup>a</sup>	Anglers Observed	Anglers Interviewed	Reported Chinook <sup>b</sup> Catch	Observed Chinook <sup>b</sup> harvest	Reported hours of Effort
06/05/2002	3	8	8	0	0	34
06/06/2002	2	13	13	0	0	42
06/07/2002	2	5	5	0	0	24
06/08/2002	3	19	19	0	0	58
06/11/2002	3	13	13	0	0	42
06/12/2002	2	32	32	0	0	146
06/13/2002	2	10	10	1	0	38
06/14/2002	3	34	34	0	0	172
06/17/2002	3	35	35	3	0	223
06/18/2002	2	31	31	0	0	148
06/19/2002	2	29	29	0	0	142
06/20/2002	3	60	60	1	0	256
06/23/2002	3	93	93	5	0	530
06/24/2002	2	64	64	6	0	272
06/25/2002	2	78	78	1	0	309
06/26/2002	3	39	39	1	0	197
06/29/2002	3	69	69	4	0	286
06/30/2002	2	57	57	22	0	305
07/01/2002	2	60	60	18	0	352
07/02/2002	3	33	33	2	0	173
07/05/2002	3	45	45	1	0	212
07/06/2002	2	32	32	4	4	140
07/07/2002	2	34	34	3	3	149
07/08/2002	3	24	24	1	0	119
07/11/2002	3	30	30	11	8	127
07/12/2002	2	16	16	8	8	80
07/13/2002	2	21	21	9	9	96
07/14/2002	3	25	25	4	2	113
07/17/2002	3	11	11	2	1	44
07/18/2002	2	6	6	6	3	25
07/19/2002	2	5	5	1	1	15
07/20/2002	3	27	27	1	1	145
07/23/2002	3	11	11	2	0	48
07/24/2002	2	18	18	3	3	83
07/25/2002	2	15	15	0	0	47
07/26/2002	3	9	9	0	0	27
<b>Total</b>		1,111	1,111	120	43	5,219

<sup>a</sup> 2 = Mid-day (1200 to 1800), 3 = Late-day (1800 to 2400).

<sup>b</sup> Chinook salmon of all sizes.

**Appendix A4.**—Summary of creel survey sampling results by interview period and date at the Lower Landing access location on the Situk River, 2003.

Date	Interview period <sup>a</sup>	Anglers observed	Anglers interviewed	Reported Chinook <sup>b</sup> catch	Observed Chinook <sup>b</sup> harvest	Reported hours of effort
06/05/03	3	3	3	0	0	10
06/06/03	2	17	17	0	0	57
06/07/03	2	2	2	0	0	8
06/08/03	3	9	9	0	0	58
06/11/03	3	26	26	1	1	82
06/12/03	2	12	12	1	1	57
06/13/03	2	17	17	1	1	92
06/14/03	3	33	33	1	1	75
06/17/03	3	12	12	0	0	48
06/18/03	2	30	30	1	0	119
06/19/03	2	15	15	1	1	58
06/20/03	3	28	28	7	5	133
06/23/03	3	66	66	15	14	294
06/24/03	2	42	42	11	8	204
06/25/03	2	47	47	9	8	176
06/26/03	3	69	69	16	16	241
06/29/03	3	59	59	7	6	313
06/30/03	2	57	57	35	35	329
07/01/03	2	50	50	35	26	269
07/02/03	3	40	40	13	8	186
07/05/03	3	35	35	27	20	179
07/06/03	2	59	59	26	20	318
07/07/03	2	50	50	64	24	303
07/08/03	3	58	58	30	22	315
07/11/03	2	62	62	29	22	393
07/13/03	2	20	20	10	6	89
07/14/03	2	24	24	1	1	115
07/14/03 <sup>c</sup>	3	51	51	22	20	255
07/17/03	3	30	30	14	14	156
07/18/03	2	29	29	5	5	182
07/19/03	2	24	24	21	14	142
07/20/03	3	27	27	17	16	162
07/23/03	3	14	14	11	4	54
07/24/03	2	10	10	23	17	43
07/25/03	2	15	15	14	14	54
07/26/03	3	5	5	0	0	19
		1,147	1,147	468	350	5,582

<sup>a</sup> 2 = Mid-day (1100 to 1730), 3 = Late-day (1730 to 2400).

<sup>b</sup> Chinook salmon of all sizes.

<sup>c</sup> Rescheduled for missed day.

**Appendix A5.**—Major computer files used for data analysis of Situk River Chinook and sockeye salmon roadside fisheries in 2000, 2001, 2002, and 2003.

<b>File name</b>	<b>File type</b>	<b>File Description</b>
Situk00-03.sas	SAS Program File	SAS code for 2000-2003 effort, harvest, and catch estimates
LLDataOnly2000 sf.xls	Microsoft Excel Workbook	2000 Situk creel data
2001SCdata sf.xls	Microsoft Excel Workbook	2001 Situk creel data
Final 2002 Situk Creel Data sf.xls	Microsoft Excel Workbook	2002 Situk creel data
2003 Creel Data sf.xls	Microsoft Excel Workbook	2003 Situk creel data

**Note:** Custodians of data files listed above include the author and the Alaska Department of Fish and Game, Division of Research and Technical Services, Anchorage, Alaska. File archive name is “Yakutat05-01.zip.”

**Appendix A6.**–Situk-Ahrnklin Inlet and Lost River Chinook Salmon Fishery Management Plan.

**5 AAC 30.365.**

(a) The purpose of this management plan is to ensure a biological escapement goal of spawning Chinook salmon to the Situk – Ahrnklin River systems. This management plan provides guidelines to the department in an effort to preclude allocation conflicts between the various user groups of this resource. Action points and associated ranges within the plan are intended to be based on the current Chinook salmon escapement goal ranges for the Situk River system.

**(b) The biological escapement goal for the Situk River Chinook salmon is 730 large fish (three ocean age and older) with a range of 450 to 1,050 fish.**

(c) The department shall manage the commercial, sport, and subsistence fisheries as follows:

(1) if the projected return of Chinook salmon to the Situk River weir is less than 350 Chinook salmon (three ocean age and older) the department shall close, by emergency order, the Chinook salmon sport fishery in the Situk River; close the subsistence, personal use, and commercial set gillnet fisheries in the Situk-Ahrnklin Inlet and Lost River; and close the commercial troll fishery in state waters bounded on the west by the three nautical mile line and on the north by a line extending seaward from 59° 29.70' N. lat., 139° 44.00' W. long. and intersecting with the three nautical mile line at 59° 27.77' N. lat., 139° 49.28' W. long. and on the south by a line extending seaward from 59° 20.30' N. lat., 139° 16.50' W. long. and intersecting the three nautical mile line at 59° 18.25' N. lat., 139° 21.94' W. long.;

(2) if the projected return of Chinook salmon to the Situk River weir is 350 – 450 fish (three ocean age or older) the commissioner shall, by emergency order, use one or more of the following methods for conservation purposes;

(A) establish a non-sale Chinook salmon season in the Situk-Ahrnklin Inlet and Lost River set gillnet fisheries;

(B) close the commercial troll fishery in state waters bounded on the west by the three nautical mile line and on the north by a line extending seaward from 59° 29.70' N. lat., 139° 44.00' W. long. and intersecting with the three nautical mile line at 59° 27.77' N. lat., 139° 49.28' W. long. and on the south by a line extending seaward from 59° 20.30' N. lat., 139° 16.50' W. long. and intersecting the three nautical mile line at 59° 18.25' N. lat., 139° 21.94' W. long.;

(C) restrict the weekly fishing periods in the Situk-Ahrnklin Inlet and Lost River set gillnet fisheries; and

(D) close the sport fishery for Chinook salmon in the Situk River;

(3) if the projected return of large Chinook salmon to the Situk weir is 451 – 730 fish (three ocean age or older) the commissioner shall, by emergency order, use one or more of the following methods for conservation purposes;

(A) establish a non-sale Chinook salmon season in the Situk-Ahrnklin Inlet and Lost River set gillnet fisheries;

(B) close the commercial troll fishery in state waters bounded on the west by the three nautical mile line and on the north by a line extending seaward from 59° 29.70' N. lat., 139° 44.00' W. long. and intersecting with the three nautical mile line at 59° 27.77' N. lat., 139° 49.28' W. long. and on the south by a line extending seaward from 59° 20.30' N. lat., 139° 16.50' W. long. and intersecting the three nautical mile line at 59° 18.25' N. lat., 139° 21.94' W. long.;

(C) restrict the weekly fishing periods in the Situk-Ahrnklin Inlet and Lost River set gillnet fisheries; and

-continued-

(D) restrict the sport harvest of Chinook salmon in the Situk River using one or more of the following methods;

(i) close portions of the Situk River to sport fishing for Chinook salmon;

(ii) establish a sport fishery for Chinook salmon less than 20 inches in length, bag and possession limit of 10 fish; greater than 20 inches in length but less than 28 inches in length, bag and possession limit of one fish with no annual limit; Chinook salmon greater than 28 inches in length must be released immediately and returned to the water unharmed;

(4) if the projected return of Chinook salmon to the Situk River weir is greater than 730 fish but less than 1,050 fish (three ocean age and older) the department shall,

(A) manage the commercial set gillnet fisheries in the Situk-Ahrnklin Inlet and Lost River based on the sockeye salmon run strength;

(B) manage the commercial troll fishery as specified in 5 AAC 29.100 in state waters bounded on the west by the three nautical mile line and on the north by a line extending seaward from 59° 29.70' N. lat., 139° 44.00' W. long. and intersecting with the three nautical mile line at 59° 27.77' N. lat., 139° 49.28' W. long. and on the south by a line extending seaward from 59° 20.30' N. lat., 139° 16.50' W. long. and intersecting the three nautical mile line at 59° 18.25' N. lat., 139° 21.94' W. long.; and

(C) establish a sport fishery for Chinook salmon less than 20 inches in length; with a bag and possession limit of 10 fish, greater than 20 inches in length, bag and possession limit of one fish with no annual limit;

(5) if the projected spawning escapement of Chinook salmon to the Situk River weir is greater than 1,050 fish (three ocean age and older) the department shall manage the commercial, sport and subsistence fisheries as necessary to harvest large Chinook salmon in excess of the escapement goal range; to achieve this goal the department shall establish a sport fishery for Chinook salmon less than 20 inches in length, with a bag and possession limit of 10 fish; greater than 20 inches in length, bag and possession limit of one fish with no annual limit; in addition the department may

(A) liberalize seasons, areas, method and means in the Situk River; and

(B) increase bag and possession limits for Chinook salmon greater than 28 inches in length, to three fish per day and six in possession, no annual limit.

**Appendix A7.**—Equations used to estimate effort, catch, harvest, and age composition.

### EFFORT, CATCH AND HARVEST

Angler harvest and catch of Chinook salmon, and effort (in hours) in each time-of-day (TOD) stratum was estimated using procedures for a stratified two-stage sample survey (Cochran 1977) where "days" (mid- or late-day periods) are first stage sampling units and "anglers" are second stage sampling units. First, the mean harvest (or catch or effort) was obtained over all anglers interviewed within each sampled day:

$$\bar{n}_{hi} = \frac{\sum_{j=1}^{m_{hi}} n_{hij}}{m_{hi}} \quad (1)$$

where  $n_{hij}$  is the number of Chinook salmon harvested (or caught, etc.) by interviewed person  $j$  during sampled day  $i$  for TOD stratum  $h$ , and  $m_{hi}$  is the number of people interviewed during each day. This estimate was then multiplied by the number of people (counted) who exit the site during the day ( $M_{hi}$ ) to estimate a total for each sampled day:

$$\hat{N}_{hi} = M_{hi} \bar{n}_{hi} \quad (2)$$

The mean harvest over all days sampled within each stratum was then estimated:

$$\bar{\hat{N}}_h = \frac{\sum_{i=1}^{d_h} \hat{N}_{hi}}{d_h} \quad (3)$$

where  $d_h$  is the number of days sampled in each stratum. Finally, this estimate was multiplied by the number of days in the stratum ( $D_h$ ) to estimate a total for each stratum:

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

The variances of the stratum estimates were estimated as

$$\hat{V}[\hat{N}_h] = (1 - f_{1h}) D_h^2 \frac{S_{1h}^2}{d_h} + \frac{D_h}{d_h} \sum_{i=1}^{d_h} \hat{V}[\hat{N}_{hi}], \quad (5)$$

where  $f_{1h} = d_h/D_h$  is the sample fraction for "days",  $S_{1h}^2$  is sample variance among "days", and  $d_h'$  is the number of days in which  $s_{2hi}^2$  (see below) are estimable (i.e., when at least two people are interviewed or the number interviewed equals the number counted). The among-day sample variance for the late-day stratum (days selected systematically) was estimated as follows (Wolter 1985):

$$S_{1h}^2 \approx \frac{\sum_{i=2}^{d_h} (\hat{N}_{hi} - \hat{N}_{h(i-1)})^2}{2(d_h - 1)}. \quad (6)$$

-continued-

To be conservative, the among-day sample variance for the mid-day stratum (days selected systematically but with a non-regular sampling interval ) was estimated assuming simple random sampling:

$$S_{1h}^2 \approx \frac{\sum_{i=1}^{d_h} (\hat{N}_{hi} - \bar{\hat{N}}_h)^2}{(d_h - 1)}. \quad (7)$$

The variance of daily harvest estimates was estimated as shown below. It was usually 0 because all anglers exiting the fishery were interviewed.

$$\hat{V}[\hat{N}_{hi}] = \left(1 - \frac{m_{hi}}{M}\right) M_{hi}^2 \frac{s_{2hi}^2}{m_{hi}} \quad (8)$$

The among-angler sample variance  $s_{2hi}^2$  was calculated as

$$s_{2hi}^2 = \frac{\sum_{j=1}^{m_{hi}} (n_{hij} - \bar{n}_{hi})^2}{m_{hi} - 1}. \quad (9)$$

Harvest and catch by location was estimated by substituting appropriate statistics into equations (1) through (9), above. For example, to estimate harvest above the weir,  $n_{hik}$  in equation (1) would be the number of Chinook salmon harvested above the weir in day  $i$  by angler  $k$ .

Total estimates of angler effort, catch, and harvest by species, and their variances, were obtained by summing across TOD strata.

#### AGE COMPOSITION OF CHINOOK SALMON

The proportions of harvested Chinook salmon by age and sex were estimated as follows:

$$\hat{p}_z = \frac{n_z}{n_a} \quad (10)$$

$$\hat{V}[\hat{p}_z] = \left(1 - \frac{n_a}{\hat{N}}\right) \frac{\hat{p}_z(1 - \hat{p}_z)}{n_a - 1} \quad (11)$$

where  $\hat{p}_z$  is the estimated proportion of Chinook salmon in age and/or sex category  $z$ ,  $n_a$  is the number of sampled fish classified by age and/or sex,  $n_z$  is the subset of  $n_a$  belonging to category  $z$ , and

$$\hat{N} = \sum_{h=1}^L \hat{N}_h.$$

Harvest by age and sex, and its variance, were estimated as follows (Goodman 1960):

$$\hat{N}_z = \hat{N} \hat{p}_z \quad (12)$$

$$\hat{V}[\hat{N}_z] = \hat{N}^2 \hat{V}[\hat{p}_z] + \hat{p}_z^2 \hat{V}[\hat{N}] - \hat{V}[\hat{p}_z] \hat{V}[\hat{N}] \quad (13)$$