Fishery Data Series No. 04-27

Abundance of the Chinook Salmon Escapement on the Alsek River in 2003

by

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and

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November 2004

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries

Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Measures (fisheries)

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

Mathematics, statistics

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

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ABSTRACT

The abundance of Chinook salmon *Oncorhynchus tshawytscha* returning to spawn in the Alsek River in 2003 was estimated with a mark-recapture experiment conducted by the Alaska Department of Fish and Game, the Canadian Department of Fisheries and Oceans, and the Champaign/Aishihik First Nation. Age, sex, and length compositions for the immigration were also estimated. Set gillnets fished near the mouth of the Alsek River during May, June, and July, 2003 were used to capture 534 large (≥660 mm MEF) immigrant Chinook salmon, 508 of which were marked with individually numbered spaghetti tags, as well as two batch marks—a hole punched in their left opercle, and removal of an axillary appendage. In addition, 78 medium (440–659 mm) fish were marked. During July and August, Chinook salmon were captured at spawning sites and inspected for marks. We used a modified Petersen model to estimate that 5,105 (SE = 525) large Chinook salmon immigrated into the Alsek River above Dry Bay. Canadian fisheries on the Tatshenshini River harvested an estimated 173 large Chinook salmon, leaving an escapement of 4,932 large fish. We used a second modified Petersen model to estimate that 1,553 (SE = 449) medium (440-659mm) Chinook salmon immigrated into the Alsek River above Dry Bay. About 27% of the total estimated spawning escapement of large fish in the Alsek River were counted at the Klukshu River weir. An estimated 21.2% of the Alsek River escapement were age-1.2 fish, 58.6% age-1.3 fish, and 17.2% age-1.4 fish, with an estimated 3,403 females in the total escapement of 6,485 (SE = 691).

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, Alsek River, Klukshu River, Tatshenshini River, mark-recapture, escapement, abundance, expansion factor, age and sex composition, mean length

INTRODUCTION

The Alsek River originates in the Yukon Territory, Canada, and flows in a southerly direction into the Gulf of Alaska, southeast of Yakutat, Alaska (Figure 1). Chinook salmon *Oncorhynchus tshawytscha* returning to this river are caught primarily in commercial and subsistence set gillnet fisheries in the lower Alsek River and in recreational and aboriginal fisheries on the upper Tatshenshini River in Canada (Tables 1, 2). Small harvests of this stock are also probably taken in marine recreational and commercial fisheries near Yakutat. Exploitation of this population is managed jointly by the U.S. and Canada through a subcommittee of the Pacific Salmon Commission (PSC) as part of the U.S./Canada Pacific Salmon Treaty (PST) adopted in 1985 (TTC 1999).

Counts of Chinook salmon spawning in tributaries of the Alsek River have been collected since 1962 (Table 3). Since 1976, the Canadian Department of Fisheries and Oceans (DFO) has operated a weir at the mouth of the Klukshu River to count Chinook, sockeye *O. nerka*, and coho salmon *O. kisutch*. The Alaska Department of Fish and Game (ADF&G) has counted spawning Chinook salmon from helicopters since 1981 and earlier from fixed-wing aircraft. Escapement to the Klukshu River is difficult to count by aerial, boat or foot surveys because of deep pools and overhanging vegetation. However, surveys of the Klukshu River are conducted periodically to provide some continuity in the database in the event that funding for the weir is discontinued. The Blanchard and Takhanne rivers and Goat Creek, three smaller tributaries of the Tatshenshini River, are also surveyed annually, but counts from these surveys are not used to monitor trends in escapements.

Only large (typically age-.3, -.4, and -.5) Chinook salmon ≥660 mm mideye-to-fork length (MEF) are counted during aerial or foot surveys. No attempt is made to accurately count small (typically age-.1 ≤439 mm MEF) or medium (440–659 mm and age-.2) Chinook salmon. These Chinook salmon, also called jacks, are primarily males that are considered to be surplus to spawning needs (Mecum 1990). They are easy to separate visually from their older, larger counterparts under most conditions, because of their shorter, compact bodies and lighter color. They are, however, difficult to distinguish from other smaller species such as sockeye salmon.

Figure 1.–Alsek River drainage, showing principal tributaries and river kilometers.

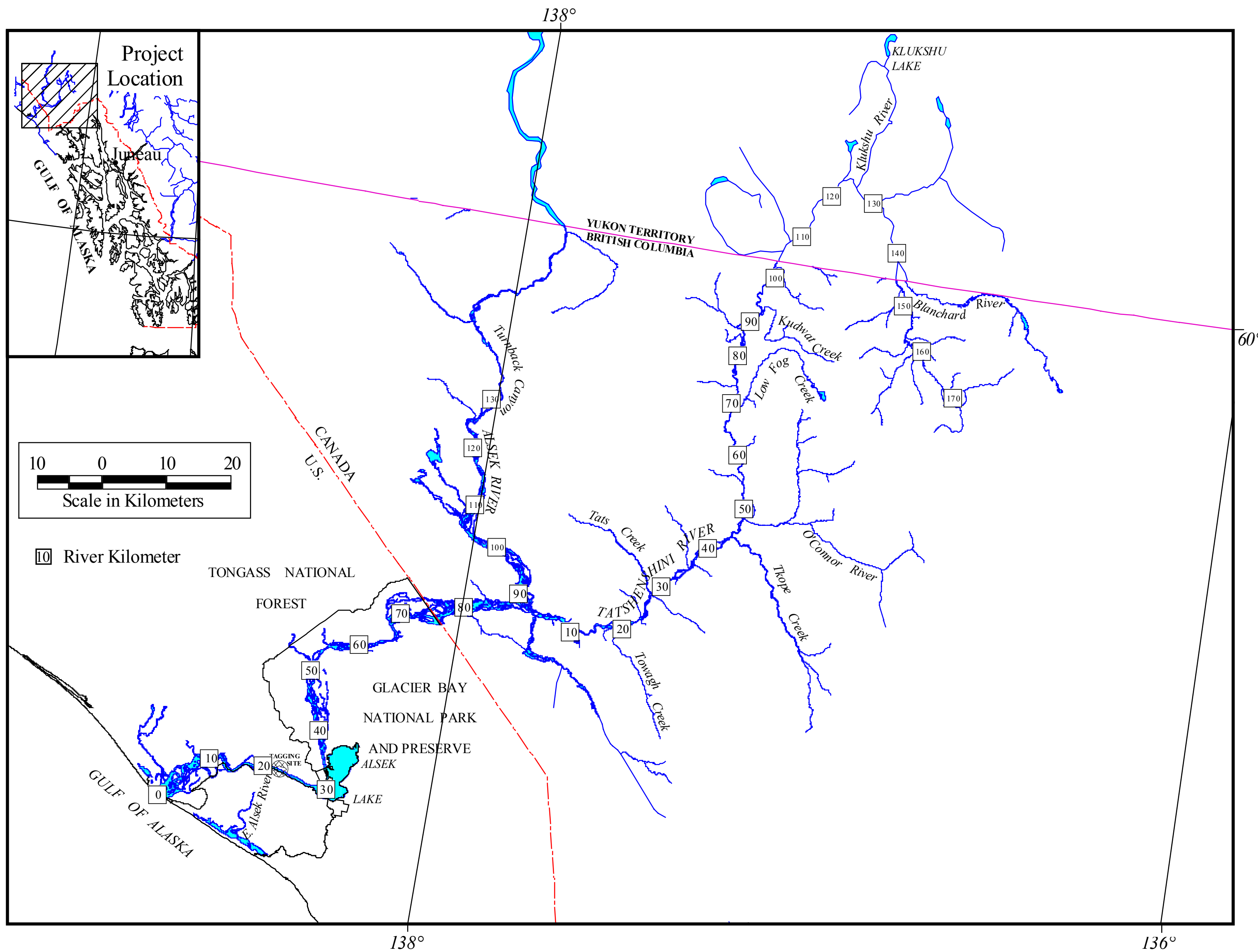


Table 1.–Estimated harvests of Chinook salmon in Canadian Alsek River fisheries, 1976–2003.

	Klukshu River aboriginal fishery			Canadian sport fishery			
Year	Below weir	Above weir	Total	Dalton Post	Blanchard River	Takhanne River	Total
1976	0	150	150	130	45	25	200
1977	0	350	350	195	67	38	300
1978	0	350	350	195	67	38	300
1979	0	1,300	1,300	422	146	82	650
1980	0	150	150	130	45	25	200
1981	0	150	150	150	200	50	400
1982	0	400	400	183	110	40	333
1983	0	300	300	202	60	50	312
1984	0	100	100	275	125	50	450
1985	0	175	175	170	20	20	210
1986	0	102	102	125	20	20	165
1987	0	125	125	326	113	63	502
1988	0	43	43	249	87	48	384
1989	0	234	234	215	75	41	331
1990	0	202	202	468	162	91	721
1991	268	241	509	384	29	17	430
1992	60	88	148	79	6	18	103
1993	88	64	152	170	25	42	237
1994	190	99	289	197	69	38	304
1995	320	260	580	601	330	113	1,044
1996	233	215	448	423	78	149	650
1997	72	160	232	195	69	34	298
1998	154	17	171	112	43	20	175
1999	211[a]	27	238	134	42	16	192
2000	21[b]	44	65	32	44	1	77
2001	33	87	120	119	31	8	157
2002	20	100	120	165	30	1	197
2003	14	76	90				83

[a] Includes 8 fish harvested from Village Creek.

[b] Includes 4 fish harvested from Village Creek and 3 from Blanchard River.

In 1997, ADF&G, in cooperation with DFO, instituted a project to determine the feasibility of a mark-recapture experiment to estimate abundance of Chinook salmon spawning in the Alsek River drainage (Pahlke and Etherton 2002). The results of the feasibility project were encouraging, and in 1998 a revised, expanded mark-recapture study was conducted along with a radiotelemetry study to estimate spawning distribution (Pahlke et al. 1999). From 1999 to 2001 the project has continued without the radiotelemetry study, and in 2002 the radiotelemetry study was repeated.

Mark-recapture studies in 1997–2002 indicate that counts at the weir represent between 15 and 27% of the total run of Chinook salmon to the Alsek River (Pahlke et al 1999; Pahlke and Etherton 2001a; 2001b; Pahlke and Etherton 2002; Pahlke and Waugh 2003). Prior to 1997, the proportion of the total Chinook salmon escapement to the Alsek River drainage counted at the Klukshu River weir was unknown but was guessed at 64% (U.S.) 40% (Canada) (Pahlke 1997a). In 1991, the Trans-boundary River Technical Committee of the PSC recommended that an expansion factor not be adopted due to the lack of applicable studies (TTC 1991). A 1998 analysis of the biological escapement goal for Klukshu River Chinook salmon recommended a biological escapement goal (BEG) range of 1,100 to 2,300 Chinook salmon spawners in the Klukshu River (McPherson et al. 1998).

The 2003 study had three objectives: (1) to estimate the abundance of large (≥660 mm MEF) spawning Chinook in the Alsek River; (2) estimate

Table 2.–Annual harvests of Chinook salmon in the U.S. Alsek River commercial and subsistence/personal use gillnet fisheries, 1941–2003.

Year(s)	Commercial harvest	Year(s)	Commercial harvest	Subsistence/ personal use
1941	3,943	1971	1,222	
1942	0	1972	1,827	
1943	0	1973	1,757	
1944	2,173	1974	1,162	
1945	6,226	1975	1,379	
1941–1945 Average	2,468	1971–1975 Average	1,469	
1946	1,161	1976	512	
1947	266	1977	1,402	
1948	853	1978	2,441	
1949	72	1979	2,525	
1950	unknown	1980	1,382	
1946–1949 Average	588	1976–1980 Average	1,652	
1951	151	1981	779	
1952	2,020	1982	532	
1953	1,383	1983	93	
1954	1,833	1984	46	
1955	2,883	1985	213	
1951–1955 Average	1,654	1981–1985 Average	333	
1956	3,253	1986	481	22
1957	1,800	1987	347	27
1958	888	1988	223	13
1959	969	1989	228	20
1960	525	1990	78	85
1956–1960 Average	1,487	1986–1990 Average	271	38
1961	2,120	1991	103	38
1962	2,278	1992	301	15
1963	131	1993	300	38
1964	591	1994	805	60
1965	719	1995	670	51
1961–1965 Average	1,168	1991–1995 Average	436	34
1966	934	1996	771	60
1967	225	1997	568	38
1968	215	1998	550	63
1969	685	1999	482	44
1970	1,128	2000	677	73
1966–1970 Average	637	1996–2000 Average	609	56
		2001	541	19
		2002	700	60
		2003	937	24

Table 3.–Escapement of Chinook salmon to the Klukshu River and counts of spawning adults in other tributaries of the Alsek River, 1965–2003.

	Klukshu River												
	Aerial count		Weir count	Above-weir harvest			Escape- ment [b]	**Blanchard River**		**Takhanne River**		**Goat Creek**	
Year[a]				AF	Sport	Brood							
1965	100		–	–	–		100	100		250		–	
1966	1,000		–	–	–		1,000	100		200		–	
1967	1,500		–	–	–		1,500	200		275		–	
1968	1,700		–	–	–		1,700	425		225		–	
1969	700		–	–	–		700	250		250		–	
1970	500		–	–	–		500	100	(F)	100		–	
1971	300	(A)	–	–	–		300	–		205	(F)	–	
1972	1,100		–	–	–		1,100	12	(A)	250		38	(F)
1973	–		–	–	–		–	–		49	(A)	–	
1974	62		–	–	–		62	52	(A)	132	(F)	–	
1975	58		–	–	–		58	81	(A)	177	(A)	–	
1976	–		1,278	150	64		1,064	–		38	(F)	16	(F)
1977	–		3,144	350	96		2,698	–		38	(F)	–	
1978	–		2,976	350	96		2,530	–		50	(F)	–	
1979	–		4,404	1,300	0		3,104	–		–		–	
1980	–		2,673	150	0		2,487	–		–		–	
1981	–		2,113	150	0		1,963	35	(H)	11	(H)	–	
1982	633	N(H)	2,369	400	0		1,969	59	(H)	241	(H)	13	(H)
1983	917	N(H)	2,537	300	0		2,237	108	(H)	185	(H)	–	
1984	–		1,672	100	0		1,572	304	(H)	158	(H)	28	(H)
1985	–		1,458	175	0		1,283	232	(H)	184	(H)	–	
1986	738	P(H)	2,709	102	0		2,607	556	(H)	358	(H)	142	(H)
1987	933	E(H)	2,616	125	0		2,491	624	(H)	395	(H)	85	(H)
1988	–		2,037	43	0		1,994	437	E(H)	169	E(H)	54	E(H)
1989	893	E(H)	2,456	234	0	20	2,202	–		158	E(H)	34	E(H)
1990	1,381	E(H)	1,915	202	0	15	1,698	–		325	E(H)	32	E(H)
1991	–		2,489	241	0	25	2,223	121	N(H)	86	E(H)	63	E(H)
1992	261	P(H)	1,367	88	0	36	1,243	86	P(H)	77	N(H)	16	N(H)
1993	1,058	N(H)	3,303	64	0	18	3,221	326	N(H)	351	E(H)	50	N(H)
1994	1,558	N(H)	3,727	99	0	8	3,620	349	N(H)	342	E(H)	67	N(H)
1995	1,053	E(H)	5,678	260	0	21	5,397	338	P(H)	260	P(H)	–	
1996	788	N(H)	3,599	215	0	2	3,382	132	N(H)	230	N(H)	12	N(H
1997	718	P(H)	2,989	160	0	0	2,829	109	P(H)	190	P(H)	–	
1998	–		1,364	17	0	0	1,347	71	P(H)	136	N(H)	39	N(H)
1999	500	P(H)	2,193	27	0	0	2,166	371	E(H)	194	N(H)	51	N(H)
2000	–		1,365	44	0	0	1,321	168	N(H)	152	N(H)	33	N(H)
2001	–		1,825	87	0	0	1,738	543	N(H)	287	N(H)	21	N(H)
2002	-		2,240	100	0	0	2,140	351	N(H)	220	N(H)	86	E(H)
1993–2002 average	946		2,828	107	0	5	2,716	276		236		45	
2003			1,737	76	0	0	1,661	127	N(H)	105	N(H)	10	N(H)

— = no survey; (A) = aerial survey from fixed wing aircraft; (H) = helicopter survey; E = excellent survey conditions; N = normal conditions; P = poor conditions.

[a] Escapement counts prior to 1975 may not be comparable because of differences in survey dates and counting methods.

[b] Klukshu River escapement = weir count minus above weir aboriginal and sport fishery harvest, and broodstock.

the proportion of the escapement of spawning Chinook salmon in the Alsek River counted at the Klukshu River weir, and (3) to estimate the age, sex, and length compositions of Chinook salmon spawning in the Alsek River.

Annual spawning escapements of Chinook salmon in the Klukshu River system have been estimated annually by subtracting from the weir count: (1) harvests taken upstream of the weir site in an aboriginal fishery and; (2) in a sport fishery (1976–1978 only); and (3) brood stock removed at the weir site. Results from the study provide a expansion factor for index weir counts; i.e., the mark-recapture estimate of escapement divided by the escapement counted at the Klukshu River weir. Results also provide information on run timing through the lower Alsek River of Chinook salmon bound for the various spawning areas.

STUDY AREA

The Alsek River drainage covers about 28,000 km^2 (Bigelow et al. 1995). The drainage supports spawning populations of anadromous Pacific salmon, including Chinook salmon; however, most anadromous production in the Alsek drainage is limited to the Tatshenshini River because of a velocity barrier on the lower Alsek near Lowell Glacier (Turnback Canyon, rkm 130) (Figure 1). Significant numbers of Chinook salmon spawn in various tributary streams of the Tatshenshini River, including the Klukshu River, the Blanchard River, the Takhanne River, and Goat Creek (Figure 2). Other significant spawning areas exist downstream of the confluence of the Klukshu and Tatshenshini rivers in mainstream areas of the Tatshenshini and Alsek rivers. Small numbers of Chinook salmon have been documented spawning in Village, Kane, Silver, Bridge, Detour, O'Connor, Low Fog and Stanley creeks, and in the Bridge River. The Klukshu and upper Tatshenshini rivers are accessible by road from the Haines Highway.

METHODS

The number of large Chinook salmon in the Alsek River escapement was estimated from a two-event mark-recapture experiment for a closed population (Seber 1982:59–61). Fish captured by set gillnets in the lower river near Dry Bay and marked were included in event 1. Chinook salmon captured upstream on or near their spawning grounds constituted event 2 of the mark-recapture experiment.

DRY BAY TAGGING

Set gillnets 120 feet (36.5 m) long, 18 feet (5.5 m) deep, and made of 7.25-inch (18.5-cm) stretch mesh, were fished on the lower Alsek River, between May 15 and July 1; from May 16 through August 19, a similar net with 5¼" (13.5-cm) mesh was fished at a nearby site. Nets were fished daily unless prevented by high water. The primary fishing site for the larger-meshed gear was at approximately river kilometer (rkm) 19, just above the boundary of the Dry Bay commercial fishery. The tagging site is below all known spawning areas, and is upstream of any tidal influence. Other nearby locations were fished when water levels were too high to safely fish the primary site. The primary site for the smaller-meshed gear was upriver a few km near the outlet of Alsek Lake. Nets were watched continuously, and captured fish were removed from the net as soon as observed. Sampling effort was held reasonably constant across the temporal span of the migration. If fishing time was lost from entanglements, snags, net cleaning, etc., the lost time (processing time) was added on to the end of the day to bring fishing time for the larger-mesh gear to 8 hours/day and 7 hours/day for the smaller-mesh gear.

Captured Chinook salmon were placed in a plastic fish tote filled with water, quickly untangled or cut from the net, tagged, scale sampled, and their length and sex recorded during a visual examination (as per Johnson et al. 1993). Fish were classified as 'large' if their mideye to fork length (MEF) was $\geq$660 mm, 'medium' if between 440 and 659 mm or 'small' if <440 mm (Pahlke and Bernard 1996). General health and appearance of the fish were noted, including injuries due to handling or predators. Each uninjured fish was marked with a uniquely numbered, blue spaghetti tag, consisting of a 2" (~5-cm) section of Floy tubing shrunk onto a 15" (~38-cm) piece of 80-lb (~36.3-kg) monofilament fishing line. The monofilament was sewn through the musculature of the fish approximately 20 mm posterior and ventral to the dorsal fin and secured by crimping both ends in a line crimp.

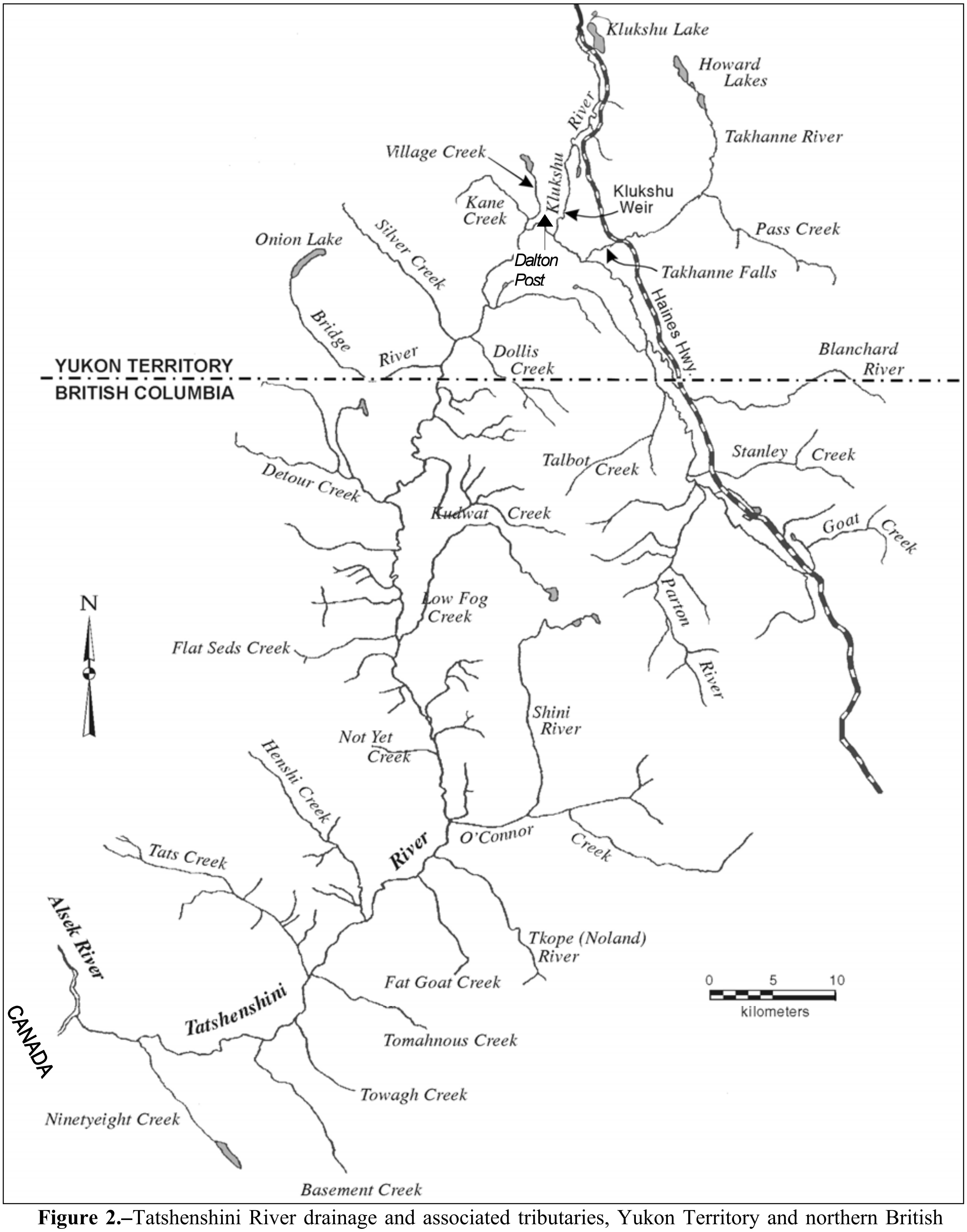


Figure 2.–Tatshenshini River drainage and associated tributaries, Yukon Territory and northern British Columbia, Canada.

Each fish was also batch marked with a ¼"-diameter (6-mm) hole in the upper (dorsal) portion of the left operculum applied with a paper punch, and by amputation of the left axillary appendage (as per McPherson et al. 1996). Fish that were seriously injured were sampled to determine their length, age and sex but were not tagged.

SPAWNING GROUND SAMPLING

During event 2, pre- and post-spawning fish were sampled at the Klukshu River weir. As fish entered a trap in the weir, a portion were captured; sampled to determine their length, sex, and age; inspected for marks; marked with a hole punched in the lower left operculum to prevent resampling; and released. In addition, some post-spawning fish and carcasses were sampled upstream of the weir and some pre-spawning fish were sampled below the weir. Foot surveys of the spawning areas on the Blanchard and Takhanne rivers were conducted July 30–August 1, 2003. Both pre- and post-spawning Chinook salmon were sampled to determine their length, sex, age and the presence of marks.

FISHERY SAMPLING

Catches in Canadian fisheries in the upper Tatshenshini River and the U.S. gillnet fisheries below the tagging site were sampled to estimate age, sex, and length and were inspected for tags.

ABUNDANCE

The number of marked fish on the spawning grounds was estimated by subtracting the estimated number of marked fish removed by fishing in U.S. fisheries (censored from the experiment) from the number of fish tagged in event 1. Handling and tagging has caused a downstream movement and/or a delay in upstream migration of marked Chinook salmon in other studies (Bernard et al. 1999, Pahlke and Etherton 1999, Bendock and Alexandersdottir 1992, Johnson et al. 1992, Milligan et al. 1984). This behavior puts fish marked in June and July at risk of capture in the downstream commercial fishery in U.S. waters that begins in early June; fish marked earlier would have no such risk. Censoring marked Chinook salmon killed in this fishery avoided bias in estimates of abundance from this phenomenon. The tagging program was well publicized with a reward for each tag recovered, and almost the entire U.S. catch goes through one processor where a high proportion of the U. S. catch was inspected for marks.

Because of a reward (Can$5 for spaghetti tag) for each tag returned from the inriver Canadian recreational and aboriginal fisheries, tags from all marked fish caught in these fisheries were considered recovered.

The validity of the mark-recapture experiment rests on several assumptions, including: (a) every fish has an equal probability of being marked in event 1, *or* that every fish has an equal probability of being captured in event 2, *or* that marked fish mix completely with unmarked fish; (b) *both* recruitment and 'death' (emigration) do not occur between sampling events; (c) marking does not affect catchability (or mortality) of the fish; (d) fish do not lose their marks between sampling events; (e) all recovered marks are reported; and (f) double sampling does not occur (Seber 1982). Assumption (a) implies that marking must occur in proportion to abundance during immigration, or if it does not, that there is no difference in migratory timing among stocks bound for different spawning locations, since temporal mixing can not occur in the experiment. We attempted to meet assumption (a) by fishing the same gear in a standardized method throughout the Chinook salmon migration. Assumption (a) also implies that sampling is not size or sex-selective. If capture on the spawning grounds was not size-selective, fish of different sizes would be captured with equal probability. The same is true for sex-selective sampling on the spawning grounds. If assumption (a) was met, fish sampled in upper Tatshenshini (Blanchard and Takhanne rivers) and Klukshu River spawning sites and in the recreational fishery would be marked at similar rates.

Contingency table analysis was used to test the assumption of proportional tagging. The hypothesis that fish of different sizes were captured with equal probability was also tested using two Kolmogorov-Smirnov (K-S) 2-sample tests ($\alpha = 0.05$). These hypotheses tests and adjustments for bias are described in Appendix C. Assumption (b) was met because the life history of Chinook salmon isolates those fish returning to the Alsek River as a ‘closed’ population. We assumed marked and unmarked fish experience the same mortality (assumption c) due to natural causes, and censoring was used to adjust the potentially higher harvest rate of marked fish in the U.S. commercial fishery.

To minimize effects of tag loss, all marked fish received secondary (a dorsal left opercle punch), and tertiary marks (the left axillary appendage was clipped). Similarly, we inspected all fish captured on the spawning grounds for marks (assumption e), and double sampling was prevented by an additional mark (ventral opercle punch) (assumption f). Variance, statistical bias, and confidence intervals for the abundance estimate were estimated with modifications of bootstrap procedures in Buckland and Garthwaite (1991).

We used the following equations to estimate the expansion factor for counts $C_{W,t}$ at the weir on the Klukshu River into estimates of abundance N_t of large Chinook salmon spawning in the Alsek River, where t is year, k is the number of estimates of π, π is the ratio (expansion factor) where i denotes years with mark-recapture experiments:

$$\hat{\pi}_i = \hat{N}_i C_{W,i}^{-1} \quad (1)$$

$$v(\hat{\pi}_i) = v(\hat{N}_i) C_{W,i}^{-2} \quad (2)$$

$$\overline{\pi} = \frac{\sum_{i=1}^{k} \hat{\pi}_i}{k} \quad (3)$$

$$v(\pi) = \frac{\sum_{i=1}^{k} (\hat{\pi}_i - \overline{\pi})^2}{k-1} \quad (4)$$

AGE, SEX, AND LENGTH COMPOSITION OF ESCAPEMENT

Scales were sampled from all fish captured in Dry Bay during event 1 and during spawning ground surveys and from portions of the Canadian aboriginal and recreational harvests to determine their age (Olsen 1995). Five scales were collected from the preferred area of each fish (Welander 1940), mounted on gum cards and impressions were made in cellulose acetate (Clutter and Whitesel 1956). Age of each fish was determined later from the pattern of circuli on images of scales magnified 70× (Olsen 1995). Samples from Dry Bay were processed at the ADF&G Scale Aging Lab in Douglas, AK; all other samples were processed at the DFO lab in Nanaimo, B.C. All scales were read by at least one staff member, with unusual or questionable scales read again by one or more staff.

The proportion of the spawning population composed of a given age within small-medium or large categories of salmon was estimated as a binomial variable from fish sampled on the spawning grounds:

$$\hat{p}_{ij} = \frac{n_{ij}}{n_i} \quad (5)$$

$$v[\hat{p}_{ij}] = \frac{\hat{p}_{ij}(1 - \hat{p}_{ij})}{n_i - 1} \quad (6)$$

where $\hat{p}_{ij}$ is the estimated proportion of the population of age j in size category i, n_{ij} is the number of Chinook salmon of age j sampled in size category i, and n_i is the number of Chinook salmon in the sample n of size category i taken on the spawning grounds.

Numbers of spawning fish by age j were estimated as the summation of products of estimated age composition and estimated abundance, minus harvest, within a size category i:

$$\hat{N}_j = \sum_i (p_{ij} \hat{N}_i) \quad (7)$$

with a sample variance calculated according to procedures in Goodman (1960):

$$v(\hat{N}_j) = \sum_i \begin{pmatrix} v(\hat{p}_{ij})\hat{N}_i^2 + v(\hat{N}_i)\hat{p}_{ij} \\ -v(\hat{p}_{ij})v(\hat{N}_i) \end{pmatrix} \quad (8)$$

The proportion of the spawning population composed of a given age was estimated by:

$$\hat{p}_j = \frac{\hat{N}_j}{\hat{N}} \quad (9)$$

where $\hat{N} = \sum \hat{N}_i$. Variance of $\hat{p}_j$ was approximated according to the procedures in Seber (1982):

$$v(\hat{p}_j) = \frac{\sum_i \left(v(\hat{p}_{ij})\hat{N}_i^2 + v(\hat{N}_i)(\hat{p}_{ij} - \hat{p}_j)^2 \right)}{\hat{N}^2} \qquad (10)$$

Sex and age-sex composition for the spawning population and associated variances were also estimated with the equations above by first redefining the binomial variables in samples to produce estimated proportions by sex $\hat{p}_k$, where k denotes sex, such that $\sum_k \hat{p}_k = 1$, and by age-sex, such that $\sum_{jk} \hat{p}_{jk} = 1$.

Age, sex, and age-sex composition and associated variances for fish passing through Dry Bay or caught in Alaskan commercial fisheries were also estimated as described above.

Estimated age composition of Chinook salmon captured in the different spawning areas was compared using a chi-square test, prior to combining these samples. Estimated age composition of samples from gillnets was compared with estimated age composition from data pooled across spawning grounds using another chi-square test. Estimates of mean length at age and their estimated variances were calculated with standard normal procedures.

RESULTS

DRY BAY

Between May 15 and July 17, 2003, 534 large (433 in larger-mesh gear, 101 in the smaller mesh) and 82 small and medium (37 in larger-mesh gear, 45 in the smaller mesh) Chinook salmon were captured in the lower Alsek River. Of these, 508 large and 78 medium fish were sampled, marked and released (Table 4, Appendix A1, A2). Fishing effort was maintained at 8 hours per day for the larger-mesh net and 7 hours per day for the smaller-mesh net (Figure 3; Appendix A1, A2). Catch rates in the larger-mesh gear ranged from 0 to 3.6 fish/net-hour and peaked on June 3, when 30 large Chinook salmon were captured (Figures 4, 5). The date of 50% cumulative catch was June 7. The sex ratio of Chinook salmon caught in the gillnets was skewed towards females (328 females, 287 males). In addition, each healthy sockeye salmon captured was marked with a spaghetti tag and released (reported in a separate study). A subset of these marked sockeye salmon were fitted with radio tags and released as part of separate mark-recapture experiment conducted by Commercial Fisheries Division and DFO.

FISHERY SAMPLING

The inriver U.S. commercial gillnet fishery harvested 937 Chinook salmon–including 6 tagged fish, and U.S. subsistence and personal use fisheries harvested 24 more (Tables 2, 4).

SPAWNING GROUND SAMPLING

Of the 1,737 Chinook salmon observed passing through the Klukshu River weir, 750 were physically handled and sampled, of which 571 were large fish and 61 were marked (Table 5). Of fish sampled at the weir, 397 were females and 351 males. One recaptured fish had lost its' tag (1.4% loss rate). Thirteen carcasses (8 large) were sampled at or above the weir and 12 Chinook (7 large) were sampled by beach seine below the weir, with 1 medium marked fish recovered in each sample.

The 987 Chinook salmon that passed through the weir were not physically handled (inspected) for marks; however, each fish was carefully observed from a short distance as they passed over a white observation board, and all tagged fish are believed to have been observed (Appendix A3). Size and sex of each of the fish not physically handled (observed) fish was not estimated.

At Blanchard River, 75 (74 large) live Chinook and carcasses were examined for marks, with 5 marked fish recovered including one missing tag (Table 4). At the Takhanne River 72 (67 large) fish were sampled with 5 tags recovered.

The aboriginal fishery near Dalton Post harvested an estimated 90 Chinook salmon with six tags returned. Most of the harvest was taken above the weir and the catch was not sampled. The sport fishery near Dalton Post harvested about 83 Chinook, with additional fish released. Seventeen (17) fish from the sport harvest were examined by DFO technicians, and 1 tagged fish was recovered.

Table 4.–Numbers of Chinook salmon marked on lower Alsek River, removed by fisheries and inspected for marks in tributaries in 2003, by length group.

		Length (MEF)			
		Small 0–439 mm	**Medium 440–659 mm**	*Large* **≥660 mm**	**Total**
A. Released at Dry Bay with marks		3	75	508	586
B. Removed by:					
1. U.S. sport/subsistence		0	0	0	0
2. U.S. gillnet		0	2	4	6
Subtotal of removals		3	2	4	6
C. Estimated number of marked fish remaining in mark-recapture experiment		3	**73**	**504**	580
D. Spawning ground samples					
Observed at Klukshu weir	Observed	16	408	1,313[a]	1,737
	Marked	1	14	107[b]	125[c]
	Marked/observed	0.25	0.0343	0.0815	0.0720
Inspected at:					
1. Klukshu weir live, carcass, seine	Inspected	7	**182**	**586**	775
	Marked	2	**8**	**61[d]**	71
	Marked/inspected		0.0440	0.1041	0.0916
2. Blanchard/ Takhanne	Inspected	0	**6**	**141**	147
	Marked	0	**0**	**10[d]**	10
	Marked/ inspected		0.0	0.0709	0.0680
3. Sport fishery	Harvest		*Estimated catch, voluntary tag retur*ns		83
	Marked				1
	Marked/inspected				0.0120
4. Aboriginal fishery	Harvest		*Estimated catch, voluntary tag returns*		90
	Marked				6
	Marked/inspected				0.0667

Note: **Numbers in bold were used in the mark-recapture estimate.**

[a] Size category estimated from sample proportions.

[b] Tags estimated from proportion of large tags in sample.

[c] Expanded for two tags for tag loss.

[d] Includes one tag loss

ABUNDANCE

Sampling on the spawning grounds proved to be non selective (by size) at Klukshu River weir and selective towards larger fish in samples taken from the Takhanne and Blanchard Rivers. We stratified the abundance estimate into separate estimates of medium and large Chinook salmon to accommodate as many samples as possible and improve precision of estimates. Samples taken at Blanchard and Takhanne Rivers were pooled because their marked fractions are not significantly different (0.066 vs 0.069, χ^2 = 0.0039, df = 1, P = 0.950). Nor was the marked fraction of this pooled sample significantly different than the marked fraction of fish *inspected* at the Klukshu River weir (0.068 vs 0.092, χ^2 = 0.730, df = 1, P = 0.393) or from the estimated marked fraction for fish *observed* at the weir (0.068 vs 0.072, χ^2 = 0.027, df = 1, P = 0.868). This outcome shows that fish had

Table 5.–Estimated abundance and composition by age and sex of the escapement of Chinook salmon in the Alsek River, 2003, using Klukshu River weir samples.

		2000	1999	1999	1998	1998	1997	1997	1996	1996	
		1.1	**2.1**	**1.2**	**2.2**	**1.3**	**2.3**	**1.4**	**2.4**	**1.5**	**Total**
Medium Chinook salmon											
Males	n	3	0	94	1	8	0	0	0	0	**106**
	%	2.0%		61.8%	0.7%	5.3%					**69.7%**
	SE of %	1.1%		4.0%	0.7%	1.8%					**3.7%**
	Escapement	31		960	10	82					**1,083**
	SE of esc.	19		284	10	36					**318**
Females	n	0	0	41	0	5	0	0	0	0	**46**
	%			27.0%		3.3%					**30.3%**
	SE of %			3.6%		1.5%					**3.7%**
	Escapement			419		51					**470**
	SE of esc.			133		26					**147**
Sexes combined	n	3	0	135	1	13	0	0	0	0	**152**
	%	2.0%		88.8%	0.7%	8.6%					**100.0%**
	SE of %	1.1%		2.6%	0.7%	2.3%					**0.0%**
	Escapement	31		1,379	10	133					**1,553**
	SE of esc.	19		401	10	51					**449**
Large Chinook salmon											
Males	n	0	0	4	0	146	6	58	0	0	**214**
	%			0.8%		27.7%	1.1%	11.0%			**40.5%**
	SE of %			0.4%		1.9%	0.5%	1.4%			**2.1%**
	Escapement			37		1,364	56	542			**1,999**
	SE of esc.			19		174	23	88			**237**
Females	n	0	0	3	0	244	6	61	0	0	**314**
	%			0.6%		46.2%	1.1%	11.6%			**59.5%**
	SE of %			0.3%		2.2%	0.5%	1.4%			**2.1%**
	Escapement			28		2,279	56	570			**2,933**
	SE of esc.			16		265	23	91			**329**
Sexes combined	n	0	0	7	0	390	12	119	0	0	**528**
	%			1.3%		73.9%	2.3%	22.5%			**100.0%**
	SE of %			0.5%		1.9%	0.6%	1.8%			**0.0%**
	Escapement			65		3,643	112	1,112			**4,932**
	SE of esc.			25		399	34	148			**525**
Medium and large Chinook salmon											
Males	n	3	0	98	1	154	6	58	0	0	**320**
	%	0.5%		15.4%	0.2%	22.3%	0.9%	8.4%			**47.5%**
	SE of %	0.3%		3.6%	0.2%	2.0%	0.4%	1.2%			**2.5%**
	Escapement	31		998	10	1,446	56	542			**3,082**
	SE of esc.	19		285	10	177	23	88			**397**
Females	n	0	0	44	0	249	6	61	0	0	**360**
	%			6.9%		35.9%	0.9%	8.8%			**52.5%**
	SE of %			1.7%		2.9%	0.4%	1.2%			**2.5%**
	Escapement			447		2,330	56	570			**3,403**
	SE of esc.			134		266	23	91			**361**
Sexes combined	n	3	0	142	1	403	12	119	0	0	**680**
	%	0.5%		22.3%	0.2%	58.2%	1.7%	17.1%			**100.0%**
	SE of %	0.3%		5.0%	0.2%	4.0%	0.5%	1.9%			**0.0%**
	Escapement	31		1,445	10	3,776	112	1,112			**6,485**
	SE of esc.	19		402	10	402	34	148			**691**

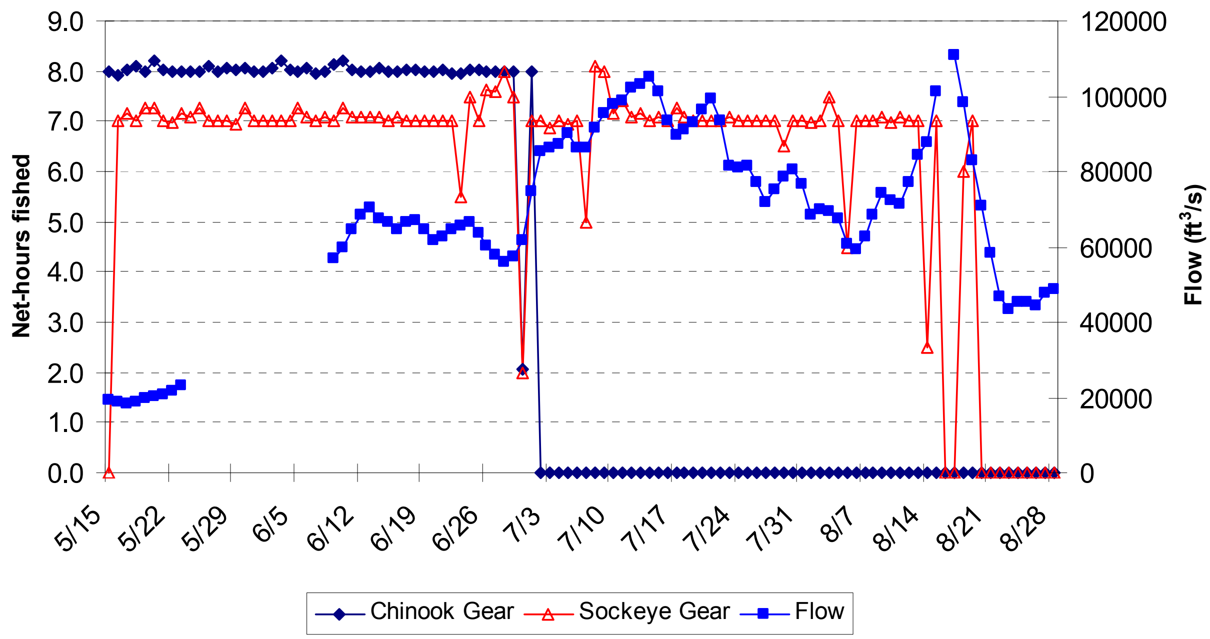


Figure 3.–Daily fishing effort **(hours)** for Chinook **(7¼")** and sockeye **(5¼")** gillnets and river flow **(ft^3/s)**, Alsek River near Dry Bay, 2003.

Note: Flow information from USGS water information system.

essentially the same probability of being captured during event 1 in Dry Bay regardless of their population within the Alsek River, which is evidence that condition *a* was met. Most of the estimated harvest in the aboriginal fisheries was not sampled and the inspected sample size in the sport fishery was too small to be included in the mark-recapture analysis.

Comparison of length distributions of fish of all sizes marked in event 1, fish captured for the first time in event 2, and marked fish recaptured in event 2, indicated no size-selective sampling at the weir; a shift away from catching medium fish at Dry Bay; and a shift to encountering large fish on the spawning grounds in the Blanchard and Takhanne rivers (Figure 6 and Table 4). The cumulative relative frequencies of fish marked (all sizes) in Dry Bay vs. fish recaptured at Klukshu weir were similar (Figure 6, lower graph, KS test P = 0.427). Fish marked in Dry Bay were larger than fish inspected at Klukshu weir (Figure 6, upper graph, KS test P < 0.001). Additionally, fish inspected at Blanchard and Takhanne Rivers were significantly larger than fish tagged in Dry Bay (Figure 6 upper panel, KS Test P <0.001) and the weir sample.

These results are consistent with use of gill nets at Dry Bay, snagging fish as a capture method on the spawning grounds, and using a weir to capture live fish on the Klukshu River. The cumulative relative frequencies of large fish marked in Dry Bay vs. large fish recaptured in the combined spawning grounds samples are similar (Figure 7). Looking at the recapture rates of medium vs. large fish at the weir supports the equal probability of capture for these fish at the weir:

	440-659 mm	> 660 mm
Marked Dry Bay	73	501
Inspected Klukshu	8	61
Marked fraction	0.110	0.122

These marked fractions were not significantly different (χ^2 = 0.071, df = 1, P = 0.790).

However, if information from sampling on the Takhanne and Blanchard rivers is to be used to produce an unbiased estimate abundance, separate estimates by size group need to be calculated, then added.

Comparison of marked fractions by size within large fish indicate that sampling of only large fish was not size-selective:

	660–833 mm	> 833 mm
Marked	35	38
Unmarked	322	318
Marked fraction	0.109	0.119

In this non-significant comparison ($\chi^2 = 0.147$, df = 1, P = 0.701), samples from the weir and spawning grounds were pooled. This outcome is sufficient to meet condition (*a*) for having a consistent estimate from Petersen's model when estimating the abundance of large fish regardless of their size.

Thus, there is evidence of size-selectivity during the first sampling event in Dry Bay and on the spawning grounds (Appendix B1). Length, sex and age data from the second sampling event were used to estimate proportions in compositions and both sampling events were stratified by size, and abundance estimated for each strata (Appendix B1).

Sex composition of large fish captured in Dry Bay was estimated to be 46% male, 49% in the Blanchard/Takhanne river samples, and 40% at the Klukshu River weir. This outcome shows that fish had essentially the same probability of being captured regardless of their sex. The gender recorded for 12 out of 78 (15%) of the fish recaptured on the spawning grounds was different from what was recorded when the fish was tagged in Dry Bay. There was no obvious bias in sex determination, with seven fish recorded as females in Dry Bay called males at recovery, and five males called females.

The mark-recapture estimate for large fish passing Dry Bay is 5,105 fish (SE = 525). An estimated 504 marked fish moved upstream, 71 of which were found in the 727 fish inspected upstream on the spawning grounds or at the weir (Table 4). A bootstrap estimate of the 95% confidence interval around the estimated abundance is 4,302 - 6,310 fish; estimated statistical bias is 1.2%.

After subtracting the Canadian inriver harvest of 173, which is primarily large fish, the estimated number of large spawners in the entire Alsek River is 4,932 fish (SE = 525).

Abundance of medium Chinook salmon was estimated 1,553 fish (SE = 449), the 95% confidence interval around the estimated abundance is 986 - 3,431 fish; estimated statistical bias is 3.9%. An estimated 73 marked fish moved upstream, 8 of which were found in the 188 fish inspected upstream on the spawning grounds or at the weir (Table 4). No tests for size-selective sampling were conducted for medium fish because few fish were marked and fewer recaptured.

The sum of the two stratified estimates gives a total estimate of medium and large escapement of 6,485 Chinook salmon, which is similar to the unstratified estimate of escapement of 6,366 Chinook salmon of all sizes. Estimated abundance by age and sex of the entire escapement is calculated in Table 5.

AGE, SEX, AND LENGTH COMPOSITION OF ESCAPEMENT

Age-1.3 Chinook salmon accounted for an estimated 58% (SE = 4%) of the escapement in 2003, with age-1.2 fish (22%) and age-1.4 fish (17%) accounting for most of the remainder (Table 5).

Estimated age compositions were significantly different for fish sampled at Dry Bay and at the Klukshu River ($\chi2 = 19.6$, df = 2, P = <0.001) and composition of fish in the Klukshu River sample differed from estimates for fish at the other spawning ground locations ($\chi2 = 62.95$, df = 2, P = <0.001; Appendix A4-A7). Because there is evidence of size-selectivity during the first sampling event in Dry Bay, samples taken at the weir were used to estimate length, sex and age composition.

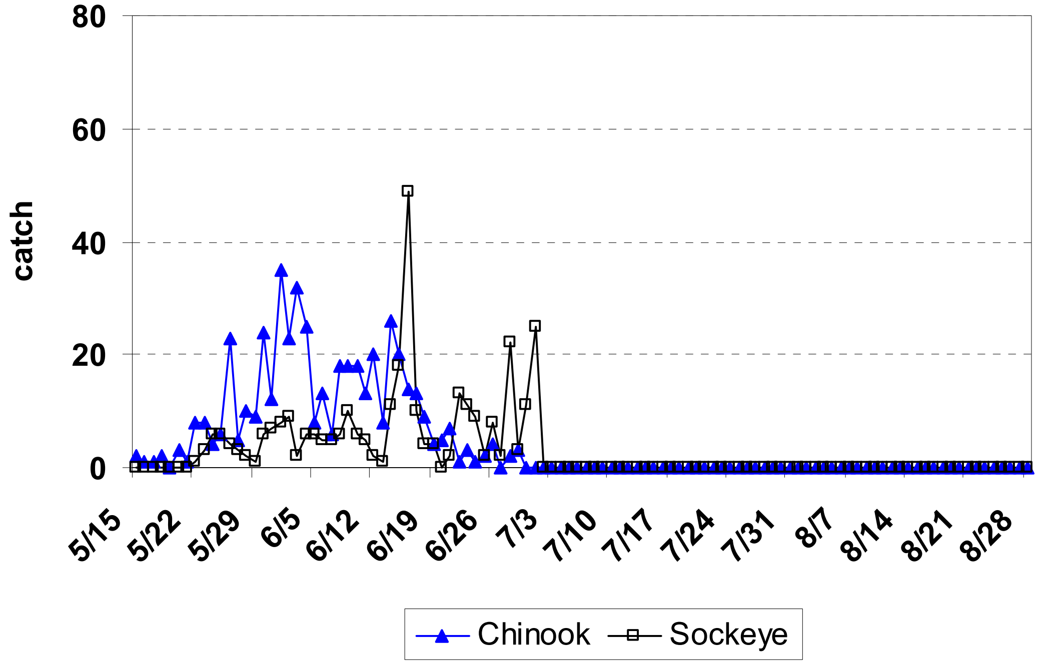


Figure 4.–Daily catch of Chinook and sockeye salmon in larger-mesh gillnet, lower Alsek River, 2003.

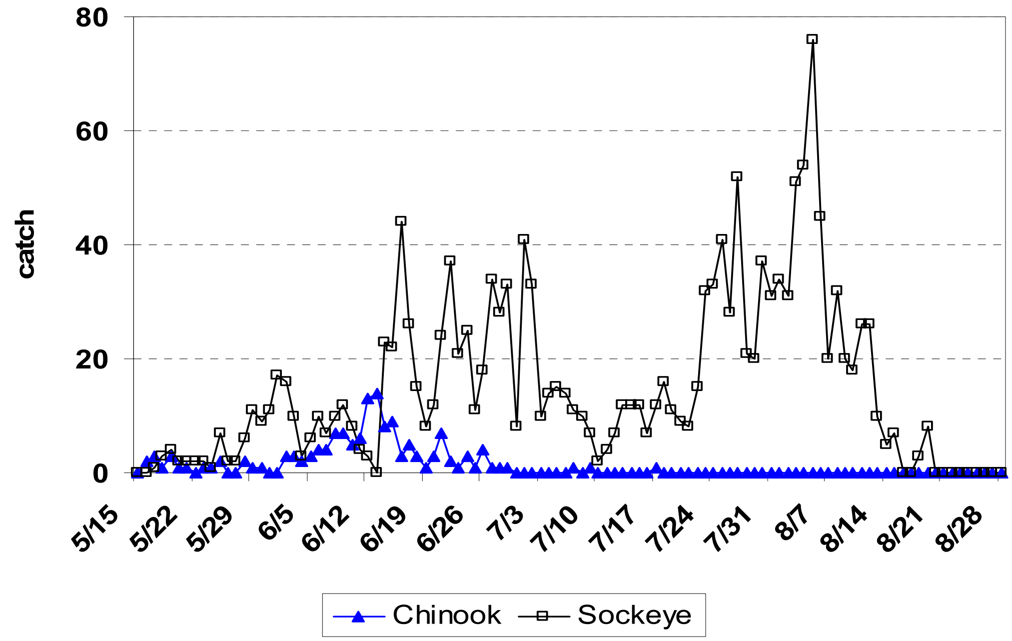


Figure 5.–Daily catch of Chinook and sockeye salmon in smaller-mesh gillnet, lower Alsek River, 2003.

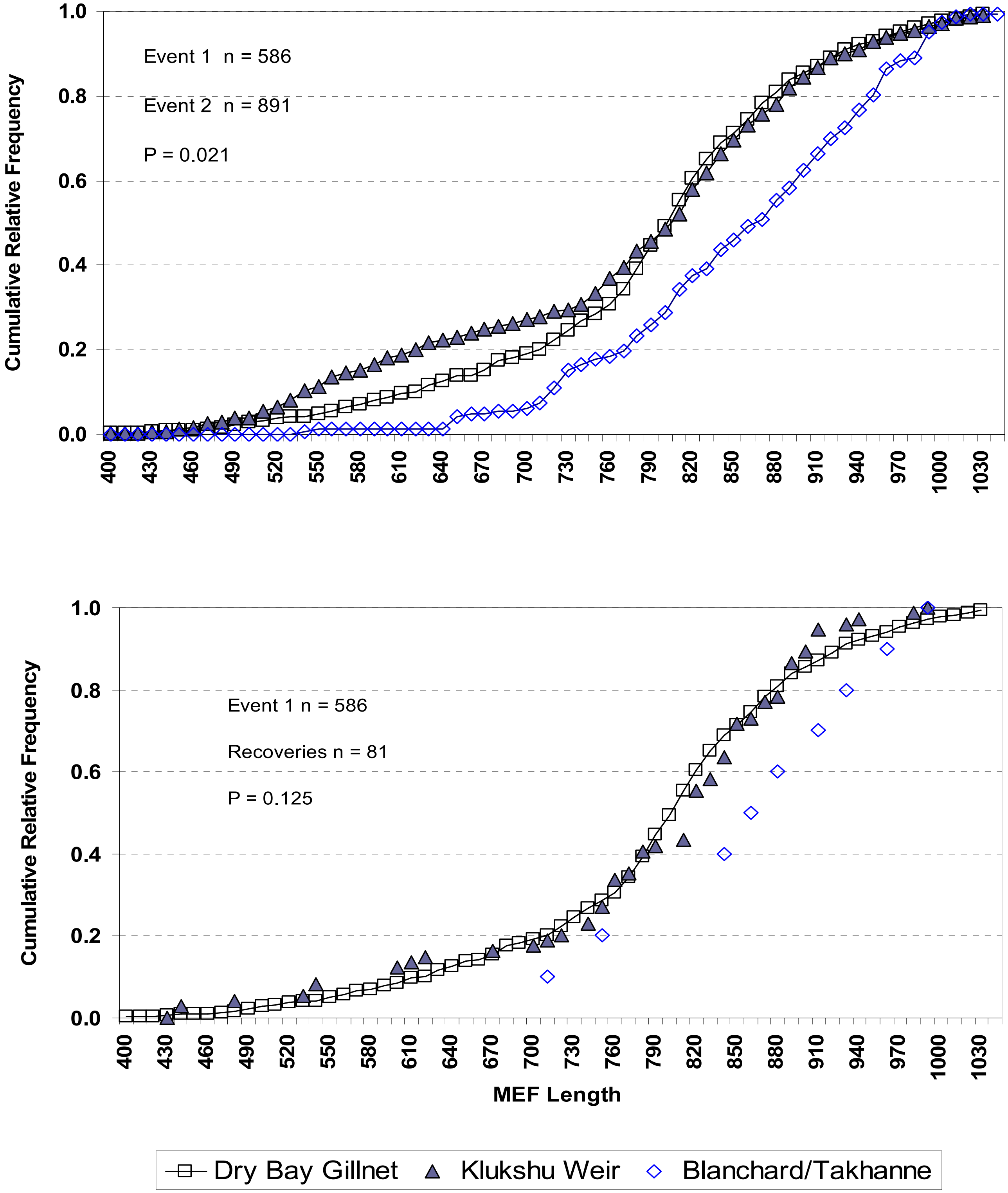


Figure 6.–Cumulative relative frequency of Chinook salmon captured in event 1 (gillnets in Dry Bay) compared with those inspected (upper graph) and marked fish recaptured (lower graph) in event 2 (combined spawning ground sampling on the Takhanne and Blanchard Rivers and at the weir on the Klukshu River), Alsek River, 2003.

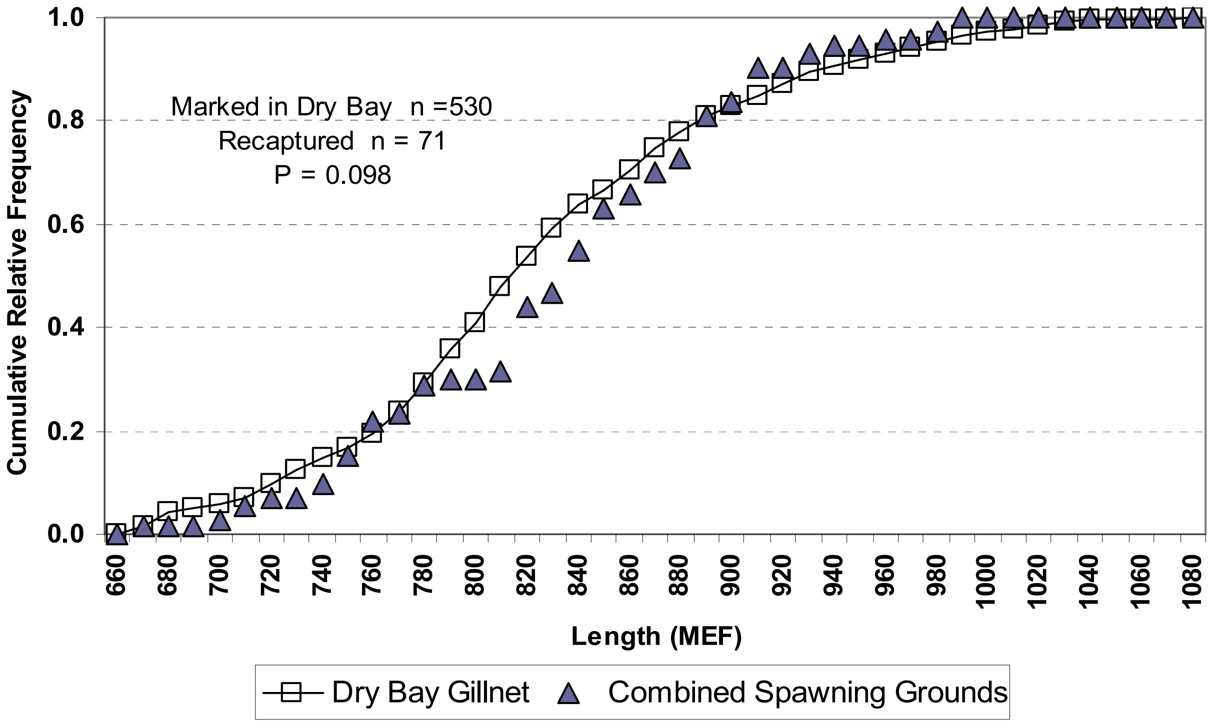


Figure 7.–Cumulative relative frequency of Large Chinook salmon captured in event 1 (gillnets in Dry Bay) compared with marked fish recaptured in event 2 (combined spawning ground sampling on the Takhanne and Blanchard Rivers and at the weir on the Klukshu River), Alsek River, 2003.

DISCUSSION

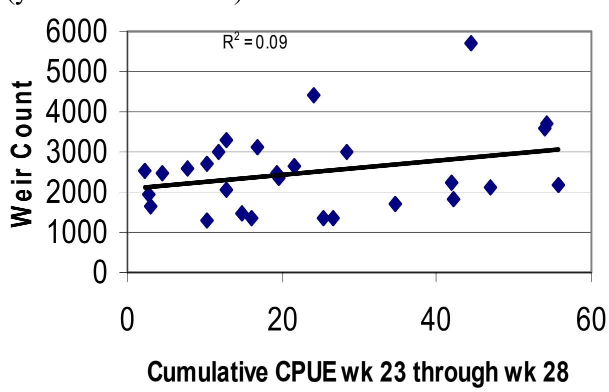
Although most fish observed in the second event of the mark-recapture experiment were not physically handled, there was no evidence that significant numbers of marked fish were not recognized as such. The blue tag used in the study was designed to prevent predators from targeting on marked fish. Our experience with these tags is that they were easy to see when small numbers of fish passed through the weir. Because size class was not recorded for fish that were passed through the weir without being handled, those samples could not be included in the stratified analysis. Radiotelemetry studies conducted in 1998 and 2002 estimated the distribution and migratory timing of spawning Chinook salmon in the Alsek and Tatshenshini rivers. Studies on the Taku, Stikine, Unuk and Chickamin rivers have shown, in general, Chinook salmon migrating to lower tributaries migrated upriver later in the year than fish heading to spawning areas much farther upriver (Pahlke and Bernard 1996; Pahlke and Etherton 1999; Pahlke et al. 1996; Pahlke 1997b). That trend was not apparent in the Alsek River studies, with fish spawning in the lower and middle Tatshenshini River, and those heading to the upper Tatshenshini River, including the Klukshu, Blanchard, Takhanne rivers and Goat Creek; all passing through Dry Bay in a similar pattern. With no significant differences in run timing, it would be unlikely that fish going to different tributaries would be marked at different rates.

Traditional indices of Chinook salmon escapement to the Alsek River indicate below average escapement in 2003. The count of 1,661 Chinook salmon at the Klukshu weir was within the escapement goal range of 1,100 to 2,300 fish (all sizes), but below the count in 2002 and below the recent 10-year average of 2,828. Index counts in the Blanchard and Takhanne rivers and Goat Creek were below average. The number of large Chinook salmon tagged at the set nets in Dry Bay increased from 245 in 1998, 402 in 1999, 479 in 2000, 529 in 2001, to 552 in 2002 due to the experience gained in operation of the nets the previous three years and the added fishing effort with smaller mesh nets. The number decreased in 2003 to 508, and would have been even lower except for better than average fishing conditions in May.

In 1999 the U.S. and Canada signed a new PST agreement which included a specific directive in Annex IV of the treaty to develop abundance-based management of Chinook salmon returning to the Stikine, Taku and Alsek rivers by 2004. On the Taku River and perhaps the Stikine River it appears feasible to estimate the abundance in-season with a mark-recapture experiment. On the Alsek River this is not feasible because of the smaller Chinook population, the lack of a suitable recapture site in the lower river and budget constraints.

Another possibility under investigation on the Stikine River that might have potential for abundance-based management for fisheries on the Alsek River is the relationship between cumulative CPUE in the mark-recapture experiment and the estimated abundance of large Chinook salmon (Der Hovanisian et al. 2004). Over the years June 8 is the average date of 50% cumulative catch in Dry Bay and probably the latest date that an abundance estimate would be useful inseason. When the cumulative CPUE through June 8, of the Chinook gear in the Dry Bay tagging project was regressed on abundance estimates from 1998 to 2003 there was no relationship (R^2 = 0.008). When the cumulative CPUE through July 4 was used the relationship was slightly better, although still poor (R^2 = 0.244).

Cumulative CPUE in the Dry Bay commercial fishery also showed little potential for inseason management. When this statistic was regressed against counts from the weir on the Klukshu River (years 1976 to 2003):



This relationship can only be examined back to 1976 when the weir was installed. Historically the commercial fishery opened in mid to late May, but since 1975, the commercial fishery has never opened before the first week in June, and effort was often low.

The use of a pre-season forecast is another option for abundance-based management. Estimated escapement of age-1.2 fish at the Klukshu River weir were regressed against estimated escapement of age-1.3 fish the following year. The regression may be meaningful (R^2 = 0.63), but when estimates of age-1.2 and 1.3 fish are regressed against following year estimates of age-1.3 and 1.4 fish the correlation breaks down (R^2 = 0.11) indicating that either the sibling relationship is weak or problems with the estimates of abundance by age.

Increased sampling effort in 2003 at the Klukshu River weir resulted in a higher proportion of the run being sampled than in the recent past. Below average escapement on the other tributaries resulted in lower sample sizes than 2002 despite increased effort.

The expansion factor π for counts at the weir estimated for 2003 is the lowest value on record (Table 6). In 2003, 75.6% of the fish inspected at the weir were large fish, resulting in an estimated escapement through the weir of 1,313 large Chinook salmon. This was about 27% of the mark-recapture estimated escapement of large fish, or an expansion factor ($\hat{\pi}_i$) of 3.76 (SE = 0.40). The average over these six estimates is $\bar{\pi}$ = 5.45 (SE = 2.68).

Table 6.–Counts of large Chinook salmon at the Klukshu River weir, mark-recapture estimates of escapement to Alsek River, percent of estimated escapement observed at the weir, and expansion factor (π).

Year	Weir Counts	M-R	SE	% Observed	π
1998	1,184	4,621	1,430	25.6	3.9
1999	1,663	11,597	2,886	14.3	7.0
2000	1,218	8,295	1,597	14.7	6.8
2001	1,538	11,022	1,336	14.0	7.2
2002	2,067	8,504	623	24.3	4.1
2003	1,313	4,932	525	26.6	3.8
Ave.	1,497	8,162	1,399	19.9	5.5

The 1999 PST agreement states that Southeast Alaska Chinook stocks will be managed for Maximum Sustained Yield (MSY) escapement goals. The escapement goal for the Klukshu River was revised in 1998 to a range of 1,100 to 2,300 Chinook salmon through the weir and that goal has been met or exceeded every year since 1976. In the 1998 escapement goal analysis, McPherson et al. recommended that the goal be reexamined in 2001 after the returns from large escapements in 1993-1996 were complete. A thorough analysis of the data has not been completed, however a cursory examination of the catch and escapement numbers in the primary return years indicate that escapements of over 3,000 Chinook did not even replace themselves. These numbers support the existing escapement goal range, pending complete analysis of recent data.

CONCLUSION AND RECOMMENDATIONS

This was the sixth attempt at estimating the total escapement of Chinook salmon to the Alsek River. Set gillnets are an effective method of capturing large Chinook salmon migrating up the Alsek River, although the tagging crew must respond to fluctuating river conditions which rapidly change the effectiveness of the gear. It appears that with the existing effort a sample size of 500 large fish tagged is possible. Sample sizes in event 2 must be increased to achieve an acceptably precise estimate of abundance, and the samples at the Klukshu River should be collected in a more systematic manner from all fish passing through the weir. This can be accomplished by increasing the effort at the weir during the period of peak migration.

The results of the study indicate that the Klukshu River weir is a valid index of Chinook salmon escapement to the Alsek River, but may be more variable than indicated in previous studies.

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APPENDIX A: GILLNET AND WEIR CATCHES AND AGE, SEX AND LENGTH SUMMARIES

Appendix A1.–Daily fishing effort (hours fished), catches, cumulative catches and catch per net hour in large-mesh (7¼ in stretch mesh) gillnets near Dry Bay, lower Alsek River, 2003.

		Large Chinook					Jack Chinook			Sockeye
			Tagged					Tagged		
Date	Hours	Caught	Daily	Cum.	Percent	CPUE	Caught	Daily	Cum.	Caught
5/15	8.0	2	2	2	0.5%	0.25	0	0	0	0
5/16	7.9	1	1	3	0.7%	0.13	0	0	0	0
5/17	8.0	1	1	4	1.0%	0.12	0	0	0	0
5/18	8.1	2	2	6	1.5%	0.25	0	0	0	0
5/19	8.0	0	0	6	1.5%	0.00	0	0	0	0
5/20	8.2	2	2	8	2.0%	0.24	1	1	1	0
5/21	8.0	1	1	9	2.2%	0.12	0	0	1	0
5/22	8.0	8	7	16	3.9%	1.00	0	0	1	1
5/23	8.0	7	6	22	5.4%	0.88	1	1	2	3
5/24	8.0	4	4	26	6.4%	0.50	0	0	2	6
5/25	8.0	6	6	32	7.9%	0.75	0	0	2	6
5/26	8.1	22	22	54	13.3%	2.72	1	1	3	4
5/27	8.0	5	5	59	14.5%	0.63	0	0	3	3
5/28	8.1	9	9	68	16.7%	1.12	1	1	4	2
5/29	8.0	8	8	76	18.7%	1.00	1	1	5	1
5/30	8.1	23	21	97	23.8%	2.85	1	1	6	6
5/31	8.0	12	12	109	26.8%	1.50	0	0	6	7
6/1	8.0	35	31	140	34.4%	4.38	0	0	6	8
6/2	8.1	22	19	159	39.1%	2.73	1	1	7	9
6/3	8.2	30	30	189	46.4%	3.65	2	2	9	2
6/4	8.0	23	23	212	52.1%	2.86	2	2	11	6
6/5	8.0	7	5	217	53.3%	0.88	1	1	12	6
6/6	8.1	11	11	228	56.0%	1.37	2	2	14	5
6/7	8.0	4	4	232	57.0%	0.50	2	2	16	5
6/8	8.0	15	15	247	60.7%	1.88	3	3	19	6
6/9	8.2	16	15	262	64.4%	1.96	2	2	21	10
6/10	8.2	15	12	274	67.3%	1.83	3	3	24	6
6/11	8.0	13	13	287	70.5%	1.62	0	0	24	5
6/12	8.0	19	19	306	75.2%	2.38	1	1	25	2
6/13	8.0	8	8	314	77.1%	1.00	0	0	25	1
6/14	8.1	26	24	338	83.0%	3.22	0	0	25	11
6/15	8.0	18	18	356	87.5%	2.25	2	2	27	18
6/16	8.0	11	9	365	89.7%	1.38	3	3	30	49
6/17	8.0	12	11	376	92.4%	1.50	1	1	31	10
6/18	8.0	9	9	385	94.6%	1.12	0	0	31	4
6/19	8.0	3	3	388	95.3%	0.38	1	1	32	4
6/20	8.0	4	3	391	96.1%	0.50	1	1	33	0
6/21	8.0	6	6	397	97.5%	0.75	1	0	33	2
6/22	8.0	1	1	398	97.8%	0.13	0	0	33	13
6/23	8.0	3	3	401	98.5%	0.38	0	0	33	11
6/24	8.0	0	0	401	98.5%	0.00	1	1	34	9
6/25	8.0	2	1	402	98.8%	0.25	0	0	34	2
6/26	8.0	3	2	404	99.3%	0.38	1	1	35	8
6/27	8.0	0	0	404	99.3%	0.00	0	0	35	2
6/28	8.0	2	1	405	99.5%	0.25	0	0	35	22
6/29	8.0	2	2	407	100.0%	0.25	1	1	36	3
6/30	2.1	0	0	407	100.0%	0.00	0	0	36	11
7/1	8.0	0	0	407	100.0%	0.00	0	0	36	25

Appendix A2.–Daily fishing effort (hours fished), catches, cumulative catches and catch per net hour in smaller-mesh (5¼ in stretch mesh) gillnets near Dry Bay, lower Alsek River, 2003.

		Large Chinook					Jack Chinook			Sockeye	Temp.
			Tagged		Cumul.			Tagged			
Date	Hours	Caught	Daily	Cum.	Tagged	CPUE	Caught	Daily	Cum.	Caught	C
5/15				0					0		
5/16	7.0	2	2	2	2.0%	0.29	0	0	0	0	2
5/17	7.2	3	3	5	5.0%	0.42	0	0	0	1	2
5/18	7.0	1	1	6	5.9%	0.14	0	0	0	3	2
5/19	7.3	3	3	9	8.9%	0.41	0	0	0	4	2
5/20	7.3	1	1	10	9.9%	0.14	0	0	0	2	2
5/21	7.0	1	1	11	10.9%	0.14	0	0	0	2	2
5/22	7.0	0	0	11	10.9%	0.00	0	0	0	2	2
5/23	7.2	1	1	12	11.9%	0.14	0	0	0	2	1
5/24	7.1	1	1	13	12.9%	0.14	0	0	0	1	2
5/25	7.3	2	2	15	14.9%	0.28	0	0	0	7	2
5/26	7.0	0	0	15	14.9%	0.00	0	0	0	2	2
5/27	7.0	0	0	15	14.9%	0.00	0	0	0	2	2
5/28	7.0	2	2	17	16.8%	0.29	0	0	0	6	2
5/29	7.0	1	1	18	17.8%	0.14	0	0	0	11	2
5/30	7.3	0	0	18	17.8%	0.00	1	1	1	9	2
5/31	7.0	0	0	18	17.8%	0.00	0	0	1	11	2
6/1	7.0	0	0	18	17.8%	0.00	0	0	1	17	2
6/2	7.0	2	2	20	19.8%	0.29	1	1	2	16	2
6/3	7.0	3	3	23	22.8%	0.43	0	0	2	10	2
6/4	7.0	1	1	24	23.8%	0.14	1	1	3	3	2
6/5	7.3	0	0	24	23.8%	0.00	3	3	6	6	2
6/6	7.1	2	2	26	25.7%	0.28	2	2	8	10	2
6/7	7.0	1	1	27	26.7%	0.14	3	3	11	7	3
6/8	7.1	5	5	32	31.7%	0.71	2	2	13	10	3
6/9	7.0	5	5	37	36.6%	0.71	2	2	15	12	3
6/10	7.3	4	4	41	40.6%	0.55	1	1	16	8	3
6/11	7.1	5	5	46	45.5%	0.70	1	1	17	4	3
6/12	7.1	10	10	56	55.4%	1.41	3	2	19	3	3
6/13	7.1	10	10	66	65.3%	1.41	4	2	21	0	3
6/14	7.1	4	4	70	69.3%	0.56	4	4	25	23	4
6/15	7.0	4	4	74	73.3%	0.57	5	5	30	22	4
6/16	7.1	3	3	77	76.2%	0.42	0	0	30	44	4
6/17	7.0	3	3	80	79.2%	0.43	2	2	32	26	
6/18	7.0	3	3	83	82.2%	0.43	0	0	32	15	4
6/19	7.0	1	1	84	83.2%	0.14	0	0	32	8	4
6/20	7.0	3	3	87	86.1%	0.43	0	0	32	12	4
6/21	7.0	3	3	90	89.1%	0.43	4	4	36	24	4
6/22	7.0	0	0	90	89.1%	0.00	2	2	38	37	4
6/23	5.5	0	0	90	89.1%	0.00	1	1	39	21	4
6/24	7.5	3	3	93	92.1%	0.40	0	0	39	25	4
6/25	7.0	1	1	94	93.1%	0.14	0	0	39	11	4
6/26	7.6	2	2	96	95.0%	0.26	2	2	41	18	4
6/27	7.6	1	1	97	96.0%	0.13	0	0	41	34	4
6/28	8.0	0	0	97	96.0%	0.00	1	1	42	28	4
6/29	7.5	1	1	98	97.0%	0.13	0	0	42	33	5
6/30	2.0	0	0	98	97.0%	0.00	0	0	42	8	5

-continued-

		Large Chinook					Jack Chinook			Sockeye	Temp
			Tagged		Cumul.			Tagged			
Date	Hours	Caught	Daily	Cum.	Tagged	CPUE	Caught	Daily	Cum.	Caught	C
7/1	7.0	0	0	98	97.0%	0.00	0	0	42	41	5
7/2	7.0	0	0	98	97.0%	0.00	0	0	42	33	5
7/3	6.9	0	0	98	97.0%	0.00	0	0	42	10	5
7/4	7.0	0	0	98	97.0%	0.00	0	0	42	14	5
7/5	7.0	0	0	98	97.0%	0.00	0	0	42	15	5
7/6	7.0	0	0	98	97.0%	0.00	0	0	42	14	5
7/7	5.0	1	1	99	98.0%	0.20	0	0	42	11	5
7/8	8.1	0	0	99	98.0%	0.00	0	0	42	10	5
7/9	8.0	1	1	100	99.0%	0.13	0	0	42	7	6
7/10	7.2	0	0	100	99.0%	0.00	0	0	42	2	5
7/11	7.4	0	0	100	99.0%	0.00	0	0	42	4	5
7/12	7.1	0	0	100	99.0%	0.00	0	0	42	7	5
7/13	7.2	0	0	100	99.0%	0.00	0	0	42	12	5
7/14	7.0	0	0	100	99.0%	0.00	0	0	42	12	5
7/15	7.1	0	0	100	99.0%	0.00	0	0	42	12	5
7/16	7.0	0	0	100	99.0%	0.00	0	0	42	7	4
7/17	7.3	1	1	101	100.0%	0.14	0	0	42	12	4
7/18	7.1	0	0	101	100.0%	0.00	0	0	42	16	5
7/19	7.0	0	0	101	100.0%	0.00	0	0	42	11	4
7/20	7.0	0	0	101	100.0%	0.00	0	0	42	9	5
7/21	7.0	0	0	101	100.0%	0.00	0	0	42	8	5
7/22	7.0	0	0	101	100.0%	0.00	0	0	42	15	5
7/23	7.1	0	0	101	100.0%	0.00	0	0	42	32	5
7/24	7.0	0	0	101	100.0%	0.00	0	0	42	33	5
7/25	7.0	0	0	101	100.0%	0.00	0	0	42	41	5
7/26	7.0	0	0	101	100.0%	0.00	0	0	42	28	4
7/27	7.0	0	0	101	100.0%	0.00	0	0	42	52	4
7/28	7.0	0	0	101	100.0%	0.00	0	0	42	21	3.5
7/29	6.5	0	0	101	100.0%	0.00	0	0	42	20	4
7/30	7.0	0	0	101	100.0%	0.00	0	0	42	37	4.5
7/31	7.0	0	0	101	100.0%	0.00	0	0	42	31	4.5
8/1	7.0	0	0	101	100.0%	0.00	0	0	42	34	5
8/2	7.0	0	0	101	100.0%	0.00	0	0	42	31	5
8/3	7.5	0	0	101	100.0%	0.00	0	0	42	51	5
8/4	7.0	0	0	101	100.0%	0.00	0	0	42	54	4.5
8/5	4.5	0	0	101	100.0%	0.00	0	0	42	76	5
8/6	7.0	0	0	101	100.0%	0.00	0	0	42	45	5
8/7	7.0	0	0	101	100.0%	0.00	0	0	42	20	4.5
8/8	7.0	0	0	101	100.0%	0.00	0	0	42	32	5
8/9	7.1	0	0	101	100.0%	0.00	0	0	42	20	5
8/10	7.0	0	0	101	100.0%	0.00	0	0	42	18	6
8/11	7.1	0	0	101	100.0%	0.00	0	0	42	26	4
8/12	7.0	0	0	101	100.0%	0.00	0	0	42	26	4
8/13	7.0	0	0	101	100.0%	0.00	0	0	42	10	5
8/14	2.5	0	0	101	100.0%	0.00	0	0	42	5	4.5
8/15	7.0	0	0	101	100.0%	0.00	0	0	42	7	5
8/16	0.0	0	0	101	100.0%		0	0	42	0	
8/17	0.0	0	0	101	100.0%		0	0	42	0	
8/18	6.0	0	0	101	100.0%	0.00	0	0	42	3	4
8/19	7.0	0	0	101	100.0%	0.00	0	0	42	8	4

Appendix A3.–Daily and cumulative counts of sockeye and Chinook salmon through the Klukshu River weir, and Chinook salmon sampled and tags observed, 2003.

Date	Sockeye daily	Chinook daily	Daily Prop.	Daily Cumul.	Cumul. prop.	Sampled daily	Sampled cumul.	Tags observed	Tags sampled
14-Jun	0	0	0.000	0	0.000		0		
15-Jun	0	0	0.000	0	0.000		0		
16-Jun	0	1	0.001	1	0.001	1	1		
17-Jun	0	0	0.000	1	0.001		1		
18-Jun	2	0	0.000	1	0.001		1		
19-Jun	0	1	0.001	2	0.001	1	2		
20-Jun	0	0	0.000	2	0.001		2		
21-Jun	0	3	0.002	5	0.003	3	5		
22-Jun	0	1	0.001	6	0.003	1	6		
23-Jun	0	2	0.001	8	0.005	2	8		
24-Jun	1	3	0.002	11	0.006	3	11		
25-Jun	2	3	0.002	14	0.008	3	14		
26-Jun	1	3	0.002	17	0.010	3	17		
27-Jun	5	5	0.003	22	0.013	4	21		
28-Jun	0	0	0.000	22	0.013	0	21		
29-Jun	4	23	0.013	45	0.026	8	29		
30-Jun	2	9	0.005	54	0.031	5	34		
1-Jul	5	6	0.003	60	0.035	6	40		
2-Jul	4	9	0.005	69	0.040	9	49		
3-Jul	2	8	0.005	77	0.044	8	57		1
4-Jul	2	13	0.007	90	0.052	13	70		
5-Jul	8	10	0.006	100	0.058	10	80		1
6-Jul	7	9	0.005	109	0.063	9	89		
7-Jul	6	18	0.010	127	0.073	16	105		
8-Jul	6	202	0.116	329	0.189	16	121	2	1
9-Jul	41	13	0.007	342	0.197	11	132		1
10-Jul	8	16	0.009	358	0.206	12	144		
11-Jul	15	17	0.010	375	0.216	17	161		2
12-Jul	14	31	0.018	406	0.234	24	185		2
13-Jul	18	38	0.022	444	0.256	36	221		2
14-Jul	326	48	0.028	492	0.283	21	242	1	7
15-Jul	17	31	0.018	523	0.301	31	273		2
16-Jul	3	26	0.015	549	0.316	17	290	1	4
17-Jul	43	99	0.057	648	0.373	20	310	5	2
18-Jul	89	239	0.138	887	0.511	22	332	18	
19-Jul	72	81	0.047	968	0.557	42	374	9	3
20-Jul	7	66	0.038	1,034	0.595	17	391	1	1
21-Jul	7	104	0.060	1,138	0.655	36	427	9	1
22-Jul	3	25	0.014	1,163	0.670	24	451		1
23-Jul	0	28	0.016	1,191	0.686	28	479		5
24-Jul	19	134	0.077	1,325	0.763	43	522	2	7
25-Jul	46	142	0.082	1,467	0.845	53	575	1	2
26-Jul	2	13	0.007	1,480	0.852	13	588		2
27-Jul	2	21	0.012	1,501	0.864	21	609		4
28-Jul	0	18	0.010	1,519	0.874	18	627		3

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Date	Sockeye daily	Chinook daily	Daily Prop.	Daily Cumul.	Cumul. prop.	Sampled daily	Sampled cumul.	Tags observed	Tags sampled
29-Jul	1	12	0.007	1,531	0.881	11	638		
30-Jul	6	19	0.011	1,550	0.892	19	657		3
31-Jul	7	11	0.006	1,561	0.899	9	666		3
1-Aug	6	24	0.014	1,585	0.912	22	688		6
2-Aug	7	33	0.019	1,618	0.931	11	699	1	
3-Aug	16	7	0.004	1,625	0.936	6	705		
4-Aug	8	7	0.004	1,632	0.940	8	713		
5-Aug	3	0	0.000	1,632	0.940	0	713		
6-Aug	370	5	0.003	1,637	0.942	0	713		
7-Aug	55	3	0.002	1,640	0.944	3	716		
8-Aug	38	8	0.005	1,648	0.949	6	722	1	2
9-Aug	96	3	0.002	1,651	0.950	1	723		
10-Aug	61	0	0.000	1,651	0.950	0	723		
11-Aug	591	22	0.013	1,673	0.963	12	735		1
12-Aug	116	6	0.003	1,679	0.967	5	740	1	
13-Aug	461	7	0.004	1,686	0.971	2	742		
14-Aug	252	7	0.004	1,693	0.975	0	742		
15-Aug	193	2	0.001	1,695	0.976	2	744		
16-Aug	109	0	0.000	1,695	0.976	0	744		
17-Aug	126	0	0.000	1,695	0.976	0	744		
18-Aug	521	2	0.001	1,697	0.977	0	744		
19-Aug	326	3	0.002	1,700	0.979	3	747		
20-Aug	305	0	0.000	1,700	0.979	0	747		
21-Aug	12	0	0.000	1,700	0.979	0	747		
22-Aug	372	3	0.002	1,703	0.980	0	747		
23-Aug	278	1	0.001	1,704	0.981	0	747		
24-Aug	112	2	0.001	1,706	0.982	0	747		
25-Aug	432	5	0.003	1,711	0.985	0	747		
26-Aug	1,083	5	0.003	1,716	0.988	1	748		
27-Aug	2,782	2	0.001	1,718	0.989	0	748		
28-Aug	2,385	8	0.005	1,726	0.994	0	748		
29-Aug	2,341	1	0.001	1,727	0.994	0	748		
30-Aug	1,093	5	0.003	1,732	0.997	0	748		
31-Aug	1,045	2	0.001	1,734	0.998	0	748		
1-Sep	2,792	3	0.002	1,737	1.000	0	748		
2-Sep	1,717	0	0.000	1,737	1.000		748		
3-Sep	1,163	0	0.000	1,737	1.000		748		
4-Sep	1,312	0	0.000	1,737	1.000		748		
5-Sep	948	0	0.000	1,737	1.000		748		
6-Sep	725	0	0.000	1,737	1.000		748		
7-Sep	610	0	0.000	1,737	1.000		748		
8-Sep	472	0	0.000	1,737	1.000		748		
9-Sep	564	0	0.000	1,737	1.000		748		
10-Sep	892	0	0.000	1,737	1.000		748		
11-Sep	944	0	0.000	1,737	1.000		748		
12-Sep	664	0	0.000	1,737	1.000		748		
13-Sep	620	0	0.000	1,737	1.000		748		

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Date	Sockeye daily	Chinook daily	Daily Prop.	Daily Cumul.	Cumul. prop.	Sampled daily	Sampled cumul.	Tags observed	Tags sampled
14-Sep	365	0	0.000	1,737	1.000		748		
15-Sep	431	0	0.000	1,737	1.000		748		
16-Sep	191	0	0.000	1,737	1.000		748		
17-Sep	106	0	0.000	1,737	1.000		748		
18-Sep	109	0	0.000	1,737	1.000		748		
19-Sep	106	0	0.000	1,737	1.000		748		
20-Sep	52	0	0.000	1,737	1.000		748		
21-Sep	172	0	0.000	1,737	1.000		748		
22-Sep	112	0	0.000	1,737	1.000		748		
23-Sep	285	0	0.000	1,737	1.000		748		
24-Sep	372	0	0.000	1,737	1.000		748		
25-Sep	340	0	0.000	1,737	1.000		748		
26-Sep	168	0	0.000	1,737	1.000		748		
27-Sep	143	0	0.000	1,737	1.000		748		
28-Sep	162	0	0.000	1,737	1.000		748		
29-Sep	172	0	0.000	1,737	1.000		748		
30-Sep	118	0	0.000	1,737	1.000		748		
1-Oct	519	0	0.000	1,737	1.000		748		
2-Oct	193	0	0.000	1,737	1.000		748		
3-Oct	120	0	0.000	1,737	1.000		748		
4-Oct	154	0	0.000	1,737	1.000		748		
5-Oct	5	0	0.000	1,737	1.000		748		
6-Oct	52	0	0.000	1,737	1.000		748		
7-Oct	0	0	0.000	1,737	1.000		748		
8-Oct	33	0	0.000	1,737	1.000		748		
9-Oct	0	0	0.000	1,737	1.000		748		
10-Oct	41	0	0.000	1,737	1.000		748		
11-Oct	4	0	0.000	1,737	1.000		748		
12-Oct	7	0	0.000	1,737	1.000		748		
13-Oct	0	0	0.000	1,737	1.000		748		
14-Oct	0	0	0.000	1,737	1.000		748		
15-Oct			0.000	1,737	1.000		748		
16-Oct			0.000	1,737	1.000				
Totals	**34,353**	**1,737**		**1,737**			**748**	**52**	**69**

Appendix A4.–Estimated age composition and mean length of Chinook salmon caught in Dry Bay, by sex and age class, 2003.

		Brood year and age class									
		2000	**1999**	**1999**	**1998**	**1998**	**1997**	**1997**	**1996**	**1996**	
		1.1	**1.2**	**2.1**	**1.3**	**2.2**	**1.4**	**2.3**	**1.5**	**2.4**	**Total**
Males	n	2	62	0	155	1	45	3	0	0	268
	%	0.7	23.1		57.8	0.4	16.8	1.1			46.4
	SE of %	0.5	2.6		3.0	0.4	2.3	0.6			2.1
	Avg. length	410	557		785	570	969	840			
	SD length	28	62		84		70	75			
	SE length	20	8		7		10	43			
Females	n	0	4	0	223	1	67	14	0	1	310
	%		1.3		71.9	0.3	21.6	4.5		0.3	53.6
	SE of %		0.6		2.6	0.3	2.3	1.2		0.3	2.1
	Avg. length		690		794	675	895	831		810	
	SD length		86		50		50	35			
	SE of esc.		43		3		6	9			
Sexes combined	n	2	66	0	378	2	112	17	0	1	578
	%	0.3	11.4		65.4	0.3	19.4	2.9		0.2	100.0
	SE of %	0.2	1.3		2.0	0.2	1.6	0.7		0.2	0.0
	Avg. length	410	565		790	622.5	925	833		810	
	SD length	28	70		66		69	41			
	SE length	20	9		3		7	10			

Appendix A5.–Estimated age composition and mean length of Chinook salmon passing through the Klukshu River weir, by sex and age class, 2003.

		Brood year and age class									
		2000	**1999**	**1999**	**1998**	**1998**	**1997**	**1997**	**1996**	**1996**	
		1.1	**1.2**	**2.1**	**1.3**	**2.2**	**1.4**	**2.3**	**1.5**	**2.4**	**Total**
Males	n	6	99		154	1	58	6			324
	%	1.9	30.6		47.5	0.3	17.9	1.9			47.3
	SE of %	0.8	2.6		2.8	0.3	2.1	0.8			1.9
	Avg. length	459	551		794	587	953	848			
	SD length	44	84		107		63	78			
	SE length	18	8		9		8	32			
Females	n	1	44		249		61	6			361
	%	0.3	12.2		69.0		16.9	1.7			52.7
	SE of %		1.7		2.4		2.0	0.7			1.9
	Avg. length	449	562		807		900	836			
	SD length		56		55		156	40			
	SE of esc.		8		3		20	16			
Sexes combined	n	7	143		403	1	119	12			685
	%	1.0	20.9		58.8	0.1	17.4	1.8			100.0
	SE of %	0.4	1.6		1.9	0.1	1.4	0.5			0.0
	Avg. length	456	554		802	587	926	842			
	SD length	32	73		66		56	65			
	SE length	12	6		3		5	19			

Appendix A6.–Estimated age composition and mean length of Chinook salmon spawning in the Blanchard and Takhanne rivers, by sex and age class, 2003.

		Brood year and age class									
		2000	1999	1999	1998	1998	1997	1997	1996	1996	
		1.1	1.2	2.1	1.3	2.2	1.4	2.3	1.5	2.4	Total
Males	n		3		41		24	0	0		68
	%		4.4		60.3		35.3				49.3
	SE of %		2.5		6.0		5.8				4.3
	Avg. length		578		793		971				
	SD length		63		92		50				
	SE length		36		14		10				
Females	n		0		30		38	2			70
	%				42.9		54.3				50.7
	SE of %				6.0		6.0				4.3
	Avg. length				803		914	840			
	SD length				42		47	0			
	SE of esc.				8		8	0			
Sexes	n		3		71		62	2			138
combined	%		2.2		51.4		44.9	1.4			100.0
	SE of %		1.2		4.3		4.2	1.0			0.0
	Avg. length		578		797		936	840			
	SD length		63		75		55	0			
	SE length		36		9		7	0			

[a] Includes one 0.4 female.

Appendix A7.–Estimated age composition and mean length of Chinook salmon harvested in the commercial set net fishery in Dry Bay, Alsek River, by sex and age class, 2003.

		Brood year and age class									
		2000	1999	1999	1998	1998	1997	1997	1996	1996	
		1.1	1.2	2.1	1.3	2.2	1.4	2.3	1.5	2.4	Total
Males	n		21		14		1				36
	%		58.3		38.9		2.8				59.0
	SE of %		8.3		8.2		2.8				6.3
	Avg. length		549		730		1010				
	SD Length		49		130		0				
	SE length		11		35						
Females	n		3		20		2				25
	%		12.0		80.0		8.0				41.0
	SE of %		6.6		8.2		5.5				6.3
	Avg. length		522		788						
	SD Length		3		107						
	SE of esc.		2		24						
Sexes	n		24		34		3				61
combined	%		39.3		55.7		4.9				100.0
	SE of %		6.3		6.4		2.8				0.0
	Avg. length		545		749		1010				
	SD Length		46		120						
	SE length		9		21						

APPENDIX B: DETECTION OF SIZE SELECTIVITY

Appendix B1.– Detection of size-selectivity in sampling and its effects on estimation of size composition.

Results of hypothesis tests (K-S and χ^2) on lengths of fish MARKED during the first event and RECAPTURED during the second event	Results of hypothesis tests (K-S) on lengths of fish MARKED during the first event and INSPECTED during the second event
Case I	
"Accept H_o"	"Accept H_o"
There is no size-selectivity during either event	
Case II	
"Accept H_o"	"Reject H_o"
There is no size-selectivity during the second sampling event but there is during the first	
Case III	
"Reject H_o"	"Accept H_o"
There is size-selectivity during both sampling events	
Case IV	
"Reject H_o"	"Reject H_o"
There is size-selectivity during the second sampling event; the status of size-selectivity during the first event is unknown	

Case I: Calculate one unstratified abundance estimate and pool lengths, sexes, and ages from both sampling events to improve precision of proportions in estimates of composition.

Case II: Calculate one unstratified abundance estimate and only use lengths, sexes, and ages from the second sampling event to estimate proportions in compositions.

Case III: Completely stratify both sampling events and estimate abundance for each stratum. Add abundance estimates across strata to get a single estimate for the population. Pool lengths, sexes, and ages from both sampling events to improve precision of proportions in estimates of composition, and apply formulae to correct for size bias to the pooled data.

Case IV: Completely stratify both sampling events and estimate abundance for each stratum. Add abundance estimates across strata to get a single estimate for the population. Use lengths, sexes, and ages from only the second sampling event to estimate proportions in compositions, and apply formulae to correct for size bias to the data from the second sampling event.

Whenever the results of the hypothesis tests indicate that there has been size-selective sampling (Case III or IV), there is still a chance that the bias in estimates of abundance from this phenomenon is negligible. Produce a second estimate of abundance by not stratifying the data as recommended above. If the two estimates (stratified and unbiased vs. biased and unstratified) are dissimilar, the bias is meaningful, the stratified estimate should be used, and data on compositions should be analyzed as described above for Case III or IV. However, if the two estimates of abundance are similar, the bias is negligible in the UNSTRATIFIED estimate, and the analysis can proceed as if there were no size-selective sampling during the second event (Case I or II).

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Case III or IV: Size-selective sampling in both sampling events	
n_i	Number of unique fish sampled during **SECOND** event **ONLY** within stratum *i*
n_{ij}	Number of unique fish of age *j* sampled during the **SECOND** event **ONLY** within stratum *i*
$\hat{p}_{ij} = \frac{n_{ij}}{n_i}$	Estimated fraction of fish of age *j* in stratum *i*. Note that $\sum_j \hat{p}_{ij} = 1$
$v(\hat{p}_{ij}) = \frac{\hat{p}_{ij}(1 - \hat{p}_{ij})}{n_i - 1}$	An unbiased of variance[a]
$\hat{N}_i$	Estimated abundance in stratum *i* from the mark-recapture experiment
$\hat{N}_j = \sum_i (\hat{p}_{ij}\hat{N}_i)$	Estimated abundance of fish in age group *j* in the population
$v(\hat{N}_j) = \sum_i (v(\hat{p}_{ij})\hat{N}_i^2 + v(\hat{N}_i)\hat{p}^2{}_{ij} - v(\hat{p}_{ij})v(\hat{N}_i))$	An unbiased estimate of variance [b]
$\hat{p}_j = \frac{\hat{N}_j}{\sum_i \hat{N}_i} = \frac{\hat{N}_j}{\hat{N}}$	Estimated fraction of fish in age group *j* in the population
$v(\hat{p}_j) = \frac{\sum_i (v(\hat{p}_{ij})\hat{N}_i^2 + v(\hat{N}_i)(\hat{p}_{ij} - \hat{p}_j)^2)}{\hat{N}^2}$	An approximate estimate of variance[c]

[a] Page 52 *in* Cochran, W. G. 1977. Sampling techniques, third edition. John Wiley and Sons, Inc. New York.

[b] From methods in Goodman, L. A. 1960. On the exact variance of products. Journal of the American Statistical Association 55:708-713.

[c] From the delta method, page 8 *in* Seber, G. A. F. 1982. The estimation of animal abundance and related parameters, second edition. Charles Griffin and Company, Ltd. London.

APPENDIX C: COMPUTER FILES USED IN THIS REPORT

Appendix C1.–Computer files used to estimate the spawning abundance and distribution of Chinook salmon in the Alsek River, 2003.

File name	Description
2003 Alsek spaghetti tag effort.XLS	EXCEL spreadsheet with gillnet tagging data--daily effort, catch by species, and water depth by site; gillnet charts.
gnawl2003.XLS	Age, sex, length (ASL) data from tagging site.
Pi_hat03.xls	Pi expansion factor calculation table
Ksoutput.doc	KS tests
Kscharts03.XLS	cumulative relative frequency charts and data
2003 Klukshu Chinook .XLS	Klukshu, Blanchard, Takhanne, ASL data