Regional Operational Plan SF.1J.2013.05

Spawning Escapement of Chinook Salmon in the Stikine River, 2013

by

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and

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May 2013

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 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)

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

REGIONAL OPERATIONAL PLAN SF.1J.2013-05

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by

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May 2013

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SIGNATURE/TITLE PAGE

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Approval

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PURPOSE

The primary goals of this study are to estimate the spawning escapement of large (≥660 mm MEF) Chinook salmon above the U.S./Canada border in the Stikine River using a modified Petersen 2 event mark-recapture project, and to estimate the age, sex and length composition of the inriver run and spawning escapement. The Alaska Department of Fish and Game (ADF&G) and Fisheries and Oceans Canada (FOC) uses these data to make terminal and regional management decisions, and the Pacific Salmon Commission (PSC) uses the data for coastwide management and stock assessment through the Chinook Technical Committee (CTC).

BACKGROUND

The Stikine River is one of the two largest producers of Chinook salmon in northern British Columbia and Southeast Alaska (Pahlke 1995), along with the Taku River. Commercial catches in the U.S. gillnet fishery in District 108 through early July (the period when mature adults return) exceeded 8,400 fish in 1959 and 7,000 fish were caught in 1974 (unpublished Chinook salmon plan for Southeast Alaska, ADF&G, Douglas, Alaska). In the mid 1970s Chinook salmon stocks were believed to be depleted and in 1978 the U.S. spring gillnet fishery directed on Chinook salmon was suspended; annual incidental harvests, taken in District 106 and 108 net fisheries targeting sockeye salmon, averaged 860 fish from 1978 to 2004. In addition, District 108 troll and spring troll fisheries harvested an average of 1,200 over the same period, while the Canadian inriver fisheries (which include the lower and upper river commercial fisheries and the test, Aboriginal, and sport fisheries) have harvested an average of 2,300 large Chinook salmon (fish ≥660 mm MEF = mid-eye to fork of tail length). The majority of the Chinook salmon catches were taken in the lower Canadian commercial fishery and were incidental to the harvest of sockeye salmon as a result of Canada prohibiting directed commercial fisheries on Chinook salmon until 2005. Canadian inriver test, Aboriginal, and sport fisheries targeted Chinook salmon and harvests were typically <1,000 large fish. Marine recreational harvests (excluded from the 1978 closure) of Stikine River Chinook salmon in the Wrangell/Petersburg area in 1985–2012 ranged from 761 to 4,300 fish.

In 1981, the Chinook salmon management program was formalized into a 15-year program designed to rebuild spawning escapements by 1995 (ADF&G 1981) in order to restore production to a level capable of supporting sustainable fisheries in Alaska and Canada. To track rebuilding, ADF&G and FOC have counted spawning Chinook salmon in a designated set of watersheds. Counts from these index areas are considered to be indicators of relative abundance based on the assumption that counts are a relatively constant proportion of the escapement to a system. Past and present escapement index counts in the Stikine River consist of: (1) a survey count of Andrew Creek, and (2) a count of Chinook salmon at a weir across the Little Tahltan River. Prior to 1991, the Little Tahltan River weir count was expanded by a factor of 4.0 to estimate total inriver escapement. However, because this expansion was not based on any scientific study, the Transboundary River Technical Committee (TTC) of the PSC decided to omit the expansion factor from escapement analyses and to simply monitor the trends in Stikine River escapement from the Little Tahltan River weir counts. An escapement goal of 5,300 large Chinook through the weir was established by the TTC (PSC 1991). Estimates of total escapement were consequently needed to determine whether the Little Tahltan River weir count was a consistent index of escapement.

Table 1.–Estimated spawning escapement of large (≥660 mm MEF) Stikine River Chinook salmon versus Little Tahltan River weir counts, 1996–2012.

Year	Estimated spawning escapement, large Chinook	Weir count, large Chinook	Weir count as % of estimated spawning escapement	Source
1996	28,949	4,821	17	Pahlke and Etherton (1998)
1997	26,996	5,557	21	Pahlke and Etherton (1999)
1998	25,968	4,879	19	Pahlke and Etherton (2000)
1999	19,947	4,738	24	Pahlke et al. (2000)
2000	27,531	6,640	24	Der Hovanisian et al. (2001)
2001	63,523	9,728	15	Der Hovanisian et al. (2003)
2002	50,875	7,490	15	Der Hovanisian et al. (2004)
2003	46,824	6,492	14	Der Hovanisian et al. (2005)
2004	48,900	16,381	33	Der Hovanisian and Etherton. (2006)
2005	39,806	7,253	18	Richards et al. 2008)
2006	24,405	3,860	16	Richards et al. (2012)
2007	14,560	562	3	Richards et al. (2012)
2008	18,352	2,634	15	Richards et al. (2012)
2009 [a]	12,803	2,245	18	Jaecks et al. (*in prep* a)
2010 [a]	15,116	1,057	7	Jaecks et al. (*in prep* b)
2011[a]	14,480	1,754	12	Jaecks et al. (*in prep* c)
2012[a]	22,327	720	3	Jaecks et al. (*in prep* d)

[a] Preliminary.

A cooperative program between ADF&G, FOC, and the Tahltan First Nation (TFN) was started in 1995 as a small-scale pilot study to estimate escapement and inriver harvest rate of Stikine River Chinook salmon. The pilot study showed that mark-recapture experiments could be used to estimate escapement of Chinook salmon to the Stikine River and a rigorous program was started in 1996. The spawning escapement of Chinook salmon to the Stikine River in 1996 was estimated to be about 29,000 large fish (Pahlke and Etherton 1998). The 1996 count through the Little Tahltan River weir was 4,821 fish, or about 17% of the escapement. In 1997 and 2005, radiotelemetry was used to estimate the relative distribution of spawners in the Stikine River. The spawning escapement in 1997 was estimated to be about 27,000 large Chinook salmon (Pahlke and Etherton 1999), and the weir count was 5,557, or about 21% of the estimated escapement. This percentage was similar to the radiotelemetry study estimate of about 18%. The spawning escapement in 2005 was estimated to be about 40,000 large Chinook salmon (Richards et.al 2008), and the weir count was 7,253, or about 18% of the estimated escapement. This was also similar to the radiotelemetry study estimate of about 17%. Similar percentages of the escapement have been observed at the Little Tahltan River weir in ensuing years, although the percentage for 2004 was higher (33%) and those for 3 of the last 6 years have been substantially lower (3% in 2007, 7% in 2010, and 3% in 2012; Table 1).

Results from this rigorous escapement program were used to develop an expansion factor for the Little Tahltan River counts prior to 1996, and for estimating spawning escapements from 1981 to 1995 (Bernard et al. 2000). The escapement goal established by the TTC is 14,000 to 28,000 large Chinook to the entire Stikine River (corresponding values for counts through the Little Tahltan River weir are 2,700 to 5,300) (Bernard et al. 2000). Estimated spawning escapements have met or exceeded the escapement goal range of 14,000 to 28,000 adult spawners since 1985, with the exception of 2009 (Table 1), were as the Little Tahtlan escapement objective has not been met since 2007.

Table 2.–Estimated harvest of large (≥660 mm MEF) Stikine River Chinook salmon, 2005–2012.

	United States				Canada					
Year	Petersburg/ Wrangell sport	D8 troll	D8 gillnet	Inriver subsistence	Lower river commercial	Upper river commercial	Aboriginal	Lower river test	Sport	Total harvest
2005	3,002	4,315	22,428	15	19,070	28	800	33	118	49,809
2006	2,944	1,898	21,892	37	15,098	22	616	0	40	42,547
2007	3,273	1,099	9,109	37	10,691	10	364	5	0	24,588
2008	1,352	1,054	7,270	26	7,241	40	769	13	46	17,811
2009	761	174	621	31	1,757	29	496	3	20	3,892
2010	994	426	520	53	2,605	16	500	5	50	5,176
2011[a]	963	471	1,431	40	2,565	14	515	27	49	6,082
2012[a]	1,110	498	2,025	53	4,527	6	513	6	64	5,116

[a] Preliminary

The Stikine River and 10 other Chinook salmon stocks in this region are used in coastwide abundance-based management by the PSC. The Stikine River is one of 50 Chinook escapement indicator stocks included in annual assessments by the CTC of the PSC to determine stock status and other requirements of the 1999 U.S./Canada Pacific Salmon Treaty. That agreement called for abundance-based management of Stikine River Chinook salmon to be developed by 2004. To that end, a coded wire tag (CWT) program was started in 2000 to improve the marine harvest and smolt estimation aspects of the stock assessment program (covered in a separate operational plan), and preseason and inseason run estimation methods were developed and are being refined. Additionally, the CTC is contemplating incorporating inriver abundance of Stikine River Chinook salmon into the PSC Chinook salmon model, which, among other things, produces annual forecasts of abundance used in setting annual harvest quotas for fisheries under the jurisdiction of the Pacific Salmon Treaty. Hence, data from this project are essential in providing effective management tools for this stock.

Chinook salmon stocks in the Stikine River have rebounded from overfishing and low survival rates in the 1970s (Bernard et al. 2000). In February 2005, an agreement was negotiated between the United States and Canada by the Transboundary Rivers Panel and approved by the PSC for directed harvest of wild Chinook salmon returning to the Stikine and Taku rivers in 2005–2008 (Annex IV, Paragraph 3). Directed commercial fisheries were re-established in District 108 and established in the lower and upper Stikine River in 2005. Approximately 50,000, 43,000, 25,000, 18,000, 4,000, 5,000, 6,000, and 5,000 large Stikine Chinook were harvested from 2005 to 2012, respectively (Table 2). Annexes to the Pacific Salmon Treaty expired in 2008, and Annex provisions were renegotiated and accepted in December 2008. Based on the current U.S./Canada harvest sharing agreement, directed commercial fisheries may occur in the U.S. and Canada when the preseason terminal run forecast exceeds about 28,100 large fish. The preseason terminal run forecast for 2013 is 32,032 large fish. However, in response to consistent overestimation of forecasts in recent years, the effective forecast was reduced 30 percent to 22,422. As a result, no directed commercial fisheries on Chinook salmon are planned in both U.S. and Canadian waters in 2013.

OBJECTIVES

The research objectives for 2013 are to:

1. Estimate the spawning escapement of large ($\geq$660 mm MEF) Chinook salmon above the U.S./Canada border such that the estimate is within 25% of the true value 95% of the time. Higher relative precision is prescribed for the 2013 experiment (versus previous years) due to recent lower sampling efficacy;
2. Estimate the age, sex, and length composition of the Chinook salmon harvested in the inriver commercial fishery such that all estimates are within 5 percentage points of their true values 95% of the time; and
3. Estimate the age, sex, and length composition of the Chinook salmon spawning above the U.S./Canada border such that all estimates are within 5 percentage points of their true values 95% of the time.

SECONDARY OBJECTIVES

1. Estimate the spawning escapement of Chinook salmon <660 mm MEF either directly from mark-recapture techniques or from the proportion estimated on the spawning grounds.
2. Estimate the inriver run at Kakwan Point of large Chinook salmon and Chinook salmon <660 mm MEF.
3. Estimate the age, sex and length composition of all Chinook salmon in the inriver run at Kakwan Point.
4. Collect heads and a scale sample from all returning Chinook salmon missing adipose fins that are sampled at Kakwan Point, the spawning grounds, and the inriver fisheries to document the marked fraction of returning fish by age (from Stikine River CWT tagging) and straying of other tagged stocks.
5. Calculate an expansion factor (spawning escapement estimate for large Chinook salmon/Little Tahltan River weir count of large Chinook salmon).
6. Collect axillary appendages from all fish tagged at Kakwan Point for genetic stock identification.

METHODS

STUDY DESIGN

Spawning Abundance

A mark-recapture experiment will be used to estimate the inriver abundance of large Chinook salmon at the US/Canada border in the Stikine River in 2013. Spawning abundance of large Chinook salmon will be estimated by subtracting the large fish harvested upriver of the border. Spawning escapement of Chinook salmon <660 mm will also be estimated using mark-recapture techniques and subtraction of relevant upriver harvest if mark-recapture sample sizes for fish <660 mm are sufficient; otherwise spawning escapement of fish <660 mm will be estimated by combining the estimate of the spawning escapement of large fish and an estimate of the proportion of large fish from spawning ground samples.

Immigrating Chinook salmon caught in drift gillnets in the vicinity of Kakwan Point will be tagged and marked as the first of 2 sampling events. During the second sampling event, Chinook salmon will be inspected for marks upriver in test, commercial, and Aboriginal fisheries, at the Little Tahltan weir, and Verrett River (Figures 1 and 2). Johnny Tashoots Creek (the outlet to Tahltan Lake), may be sampled if the resources are available.

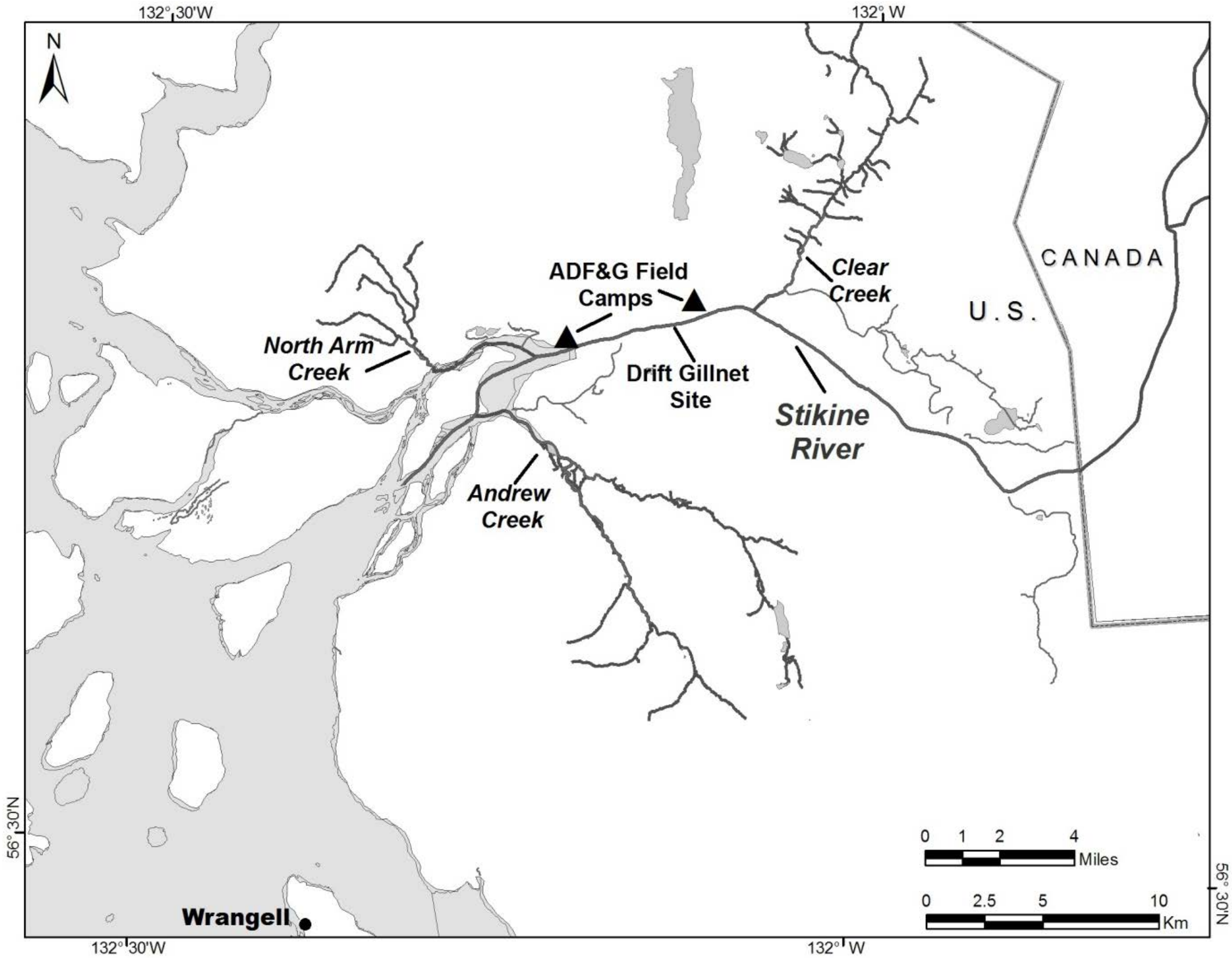

Figure 1.–Drift and set gillnet sites on lower Stikine River.

Capture and Tagging at Kakwan Point

Personnel will capture Chinook salmon in drift gillnets near Kakwan Point. Drift net capture techniques and suitable sites were developed in 1995 and are refined annually due to changing river conditions. Mesh in drift gillnets will be 18.4 cm (stretch), a size that generally catches large Chinook and some jacks (fish <660 mm MEF). Nets will be 36.6 m long and approximately 5.5 m deep.

Two skiffs will be used during the drift gillnet tagging operation and a minimum of 2 people will operate each skiff. Two crews will fish, each crew fishing 7 days per week. If one crew has a day off, the other crew will continue to fish, and sequential days with only 1 crew fishing will be avoided in an attempt to keep fishing effort as constant as possible. The ADF&G and DFO crew leaders will coordinate fishing schedules and insure that fishing is conducted as safely as possible. Crews will carefully record fishing and processing time on the **Gillnet Effort**

Recording Form (Appendix A1). The time expended fishing during each drift will be tallied and used to complete a minimum of **4 hours of fishing effort per day per crew**. Drifts at the sites identified on the lower river are short (approximately 15 min), which results in relatively high amounts of processing time and boat travel to complete each drift. Fishing operations will begin in early May and end in mid July. The first Chinook salmon has generally been captured around May 7–9, while the final capture generally occurs around July 8–9.

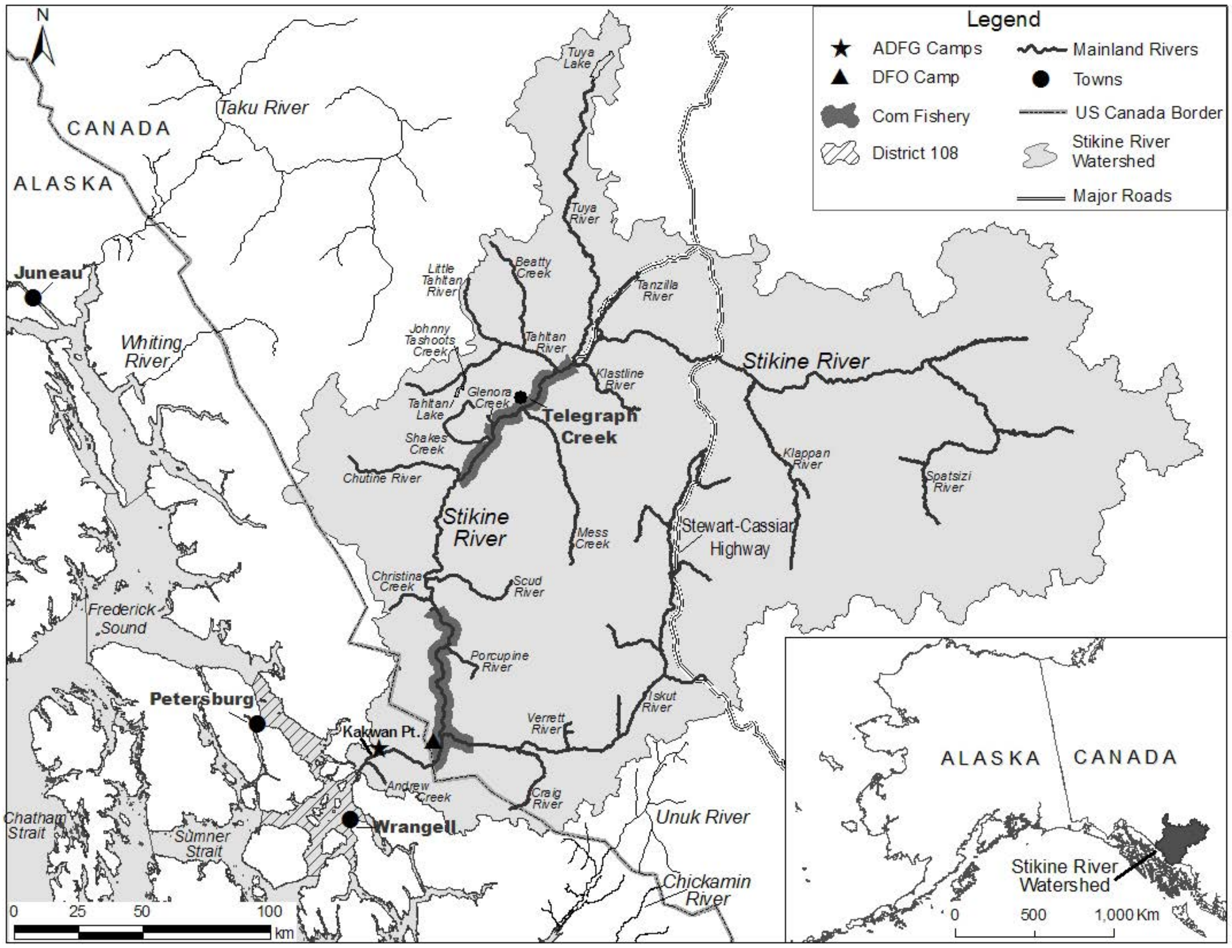

Figure 2.–Stikine River drainage, showing location of principal U.S. and Canadian fishing areas.

When capture of a Chinook salmon is indicated (tug of the net, bobbing cork line), fish will be carefully removed from the net, cutting the net if needed, and placed into a sling in a tote partially filled with water. Chinook salmon captured (any size) in good condition will be measured (both MEF and POH, i.e., postorbit of eye-to-hypural), inspected to determine their sex, sampled to collect scales, triple-marked, and released. The primary mark will be a numerically-coded spaghetti tag featuring a laminated protective sheath and a solid monofilament core that is threaded through the back of the fish at a point located approximately 2 cm below the posterior half of the dorsal fin so as to be embedded in fin rays; the ends of the monofilament core will then be crimped together. The secondary mark (a batch mark) will be a hole punched in the upper one-third of the left operculum with a paper punch (ULOP). Hole punches must be clearly severed to prevent them from healing shut. A tertiary mark (a second batch mark) will be a left axillary appendage clip (LAA). The left axillary appendage is located at the left pelvic fin. This combination of marks will ensure identification of marked fish by marking location on the spawning grounds 2–4 months later. Use of batch marks provides redundancy for cases where the primary tag is lost or unobserved. The condition (maturity) of each fish will be assessed and noted. Fish with deep wounds, damaged gills, or in a lethargic condition will be sampled for length, sex and scales and released without being tagged. There have been few such fish in the past. In 2013, the axillary appendage from each tagged fish will be collected for genetic stock identification (GSI). All axillary appendages will be stored together in full strength ethanol labeled with date, location, species, number of samples, fixative, collector, agency and phone number.

Spawning Ground Recoveries

Canadian personnel will take the lead role in sampling fish for recovery of tags at or near spawning grounds, and may be assisted by ADF&G personnel. Under ideal conditions, during the months of June, July, and August, FOC and TFN personnel will sample about 700 large Chinook salmon to measure length, determine sex, collect scales, and note presence or absence of primary, secondary and/or tertiary marks. The sample will be taken from live fish at the Little Tahltan River weir and from carcasses on spawning grounds. Every effort will be made to sample on the grounds shortly after spawning so that samples will be of fresh (newly expired) carcasses or moribund salmon. Experience has shown that delayed sampling on the grounds increases the chances of not recognizing marks on partially decomposed carcasses. DFO and TFN personnel will operate the Little Tahltan River weir from late June through late August. In early August, a second FOC and TFN crew will capture and sample Chinook salmon in Verrett River. In August, foot surveys will be conducted by ADF&G in Andrew Creek to count escapement, collect biological samples, and recover tags; this creek is downstream of the tagging site and tags recovered here will be expanded to the total estimated escapement and subtracted from the number of tags applied at the tagging site. For example, if we sample (inspect) 200 large Chinook salmon in Andrew Creek, recover 1 random tag, and the escapement is estimated to be 2000 (using a historic weir count-aerial survey relationship), 10 tags will be censored from the mark-recapture experiment (2000/200 x 1). Foot surveys will also be conducted on North Arm Creek by ADF&G Division of Commercial Fisheries (DCF) staff and tags observed there will be censored from the experiment on a per tag basis; escapement to this creek is relatively small (<100) and no historic aerial survey-weir relationship is available. If time and resources permit, Chinook salmon will be captured and sampled in Johnny Tashoots Creek, the outlet of Tahltan Lake. Other spawning sites on the Stikine River, such as the mainstem Tahltan River, where 40–50% of the population spawns, are nearly impossible to sample due to swift and deep glacial water.

Further, in a very general sense, the strategy covers the geographical distribution of the Chinook salmon population passing Kakwan Point, with the Verrett River stock representing the Iskut Riever or mid Stikine River subpopulation, and the Little Tahltan River stock representing the subpopulation of salmon spawning in the upper Stikine River. Although not part of the recapture event, sampling in Andrew and North Arm creeks provides a representation of the escapement of the lower river stocks.

Inriver Fishery Recoveries

Canadian personnel will take the lead role in sampling the inriver test fishery (Chinook and sockeye salmon) and the inriver commercial and Aboriginal gillnet fisheries for tags. Directed inriver Chinook fisheries will not take place in 2013 (based on the adjusted preseason terminal run forecast of 22,422 large fish). Therefore in 2013, with an anticipated terminal run of about 22,422 large fish, we expect about 2,600 large Chinook salmon to be included in the inspection sample (1,400 from the Chinook salmon test fishery, and we anticipate approximately 50% of the base harvest from the lower river sockeye salmon fishery will be harvested, or 1,200 out of 2,300); it is assumed that this level of anticipated harvest results in conservative sample size calculations. A reward ($5 Can.) will be offered for each tag returned, which should insure that all tags captured in the inriver fisheries are returned. Fisheries and Oceans Canada personnel will also sample commercial and, resources permitting, Aboriginal fisheries to estimate age, sex, and length (ASL) composition. Each fish will be carefully examined for spaghetti tags, for secondary marks indicating a fish that had been tagged (tags are usually removed by the fisher), and for missing adipose fins. Comparison of tag rates from the FOC sampling with those from the inriver fisheries will test the hypothesis that all tags recovered in the inriver fisheries are being reported.

Sample Size

Sample sizes for tagging and recovery are set under the consideration that we will be estimating escapement of large fish only. Large Chinook salmon are fish ≥660 mm MEF that are generally age-.3 and older (3-ocean-age and older). Chinook salmon <660 mm MEF will be tagged, however, and recoveries will be stratified by size to estimate the escapement of smaller fish, if possible. If mark-recapture data are insufficient to estimate the abundance of fish <660 mm MEF, abundance will be estimated based on the proportion of fish <660 mm MEF sampled on the spawning grounds (Secondary Objective 1).

To ensure conservative sample sizes, the larger forecast (i.e. not deprecated for recent poor returns) will be used for sample size calculations. We expect an estimated inriver run size of about 30,332 large Chinook salmon at the US/Canada border in 2013 based on a preseason sibling terminal run forecast of 32,032 large fish and removal of about 1,700 of these in U.S. marine fisheries (troll, sport and gillnet); it is noted that given a terminal run size of about 32,032, it is not likely that the entire U.S. base (3,400) catch of large fish will be harvested. Per the procedure in Robson and Regier (1964), our sampling targets for 2013 are to tag 561 large Chinook salmon at Kakwan Point and to inspect at least 3,300 large Chinook salmon (1,400 from the Canadian Chinook test fishery and 1,200 incidentally caught in the lower river sockeye salmon fishery + 700 from the spawning grounds) inriver. This sampling level will result in a 95% relative precision (RP) of 25% for an estimate of passage by Kakwan Point. Note: in the execution of meeting the tagging goal for large Chinook salmon, all Chinook salmon, regardless of size, will be tagged.

Much time has been spent finding suitable fishing sites and developing effective techniques for both sampling events. Since 2000, we have tagged an average of 684 (range 138–1,509) large Chinook salmon and inspected an average of 5,887 (range 2,123–21,381; Table 3); these sample sizes are larger than those required for Objective 1 criteria. Expecting to meet these averages in 2013 is thought to be optimistic, however, given they include large runs and catches in 2001 through 2006. In 2013, we will start fishing immediately in established fishing sites with proven techniques, while also modifying the net depth and add additional time and gear if the fishing is slow; we will also increase sampling effort at the Little Tahltan River weir to ensure adequate numbers of fish are inspected.

Table 3.–Number of Chinook salmon ≥660 mm MEF marked and inspected for marks and estimates of inriver run size, Stikine River 1996–2012.

Year	Marked	Inspected	Estimated inriver run size	Inriver CV
1996	736	1,415	31,718	6.20%
1997	674	1,793	31,509	9.40%
1998	418	1,960	28,133	14.00%
1999	254	1,155	23,716	13.70%
2000	614	3,657	30,301	10.50%
2001	1,454	5,596	66,646	8.80%
2002	935	4,375	53,893	11.00%
2003	1,089	4,696	49,881	12.20%
2004	1,509	5,914	52,538	87.40%
2005	1,228	21,381	59,885	4.20%
2006	519	16,356	40,192	16.79%
2007	343	10,691	27,023	8.80%
2008	420	7,051	26,052	11.43%
2009	138	2,123	13,419	19.05%
2010	402	3,371	18,363	10.76%
2011	507	3,335	17,652	9.10%
2012	380	5,204	27,542	10.46%
Average 2000–2012	684	5,887	35,204	

Age, Sex, Length Composition of Chinook Salmon Harvest

Age compositions for Chinook salmon harvested upriver of the border will be estimated from scales sampled from the harvest. If scale readability is 80%, then 636 scales need to be taken from the harvest (Thompson 1987: 509/0.80). More than this number of scales is expected to be collected from the harvest of the inriver fisheries. In 2013, we expect to examine 100% of the test fishery (1,400 large fish) and at least 50% of the harvest (1,200 x 0.5 large fish) for adipose fin clips/CWTs (see separate operational plan), or 2,000 fish. Sampling every second large fish inspected for adipose fin clip/CWTs for scales should produce about 1,000 (2,000/2) samples from large fish. Given that fish <660 mm will also be sampled, the sample size required for Objective 2 criteria should be easily met. Ages will be determined from patterns of circuli according to objective criteria developed by the DCF scale-aging group (Olsen 1992). Sex and length measurements from fish sampled for scales should yield estimates with precision satisfying Objective 2.

Age, Sex, Length Composition of Chinook Salmon Escapement

Age compositions for Chinook salmon captured at Kakwan Point and in each escapement spawning location (tributary) will be separately estimated. Data from separate sampling locations (including the inriver fisheries sample) may be pooled to yield the composition estimates for the escapement when compositions by age class are not meaningfully different. Samples collected at the Little Tahltan and Verrett rivers should be more representative of overall spawning escapement age composition because these systems are upstream of the inriver fisheries and if age compositions among sources vary, then the Little Tahltan and Verret river data will be used. Scales from a systematically drawn sample of 636 adult Chinook salmon must be collected from the escapement to meet objective criteria. More than this number of scales is typically collected from the various spawning locations; however we fell short of meeting the goals in 2007, 2008, 2009, and 2010 due to smaller escapements, and relatively few samples taken at the Little Tahltan River weir. For example, an average of 801 fish sampled from 1996 to 2006 at the Little Tahltan River weir alone have been successfully aged. In 2007, 2008, 2009, and 2010 only 75, 271, 108, and 163 were successfully aged. In 2011, increased efforts and techniques to increase scale sample collection were implemented and 397 fish were successfully aged from the Little Tahltan River weir. In 2012, 280 fish were successfully aged. There was a total of 400 fish, or 56% of the escapement, sampled for scales and an additional 290 fish observed for CWTs, spaghetti tags, and tag loss. In total, 90% of the escapement was handled. To meet Objective 3 criteria in 2013, we will: 1) maintain effort; 2) maintain an electric fence at the Little Tahltan River weir to deter bears; 3) maintain an upstream weir trap (first used in 2010); and 4) increase scale sampling of handled fish to account for the percentage of scales that are not readable. The execution of the collection methods at the Little Tahtlan River weir will be predicated on an approach that does not unduly affect the upstream migration of the returning Chinook salmon. Ages will be determined from patterns of circuli according to objective criteria developed by the DCF scale-aging group (Olsen 1992). These sample sizes will also provide estimates of length and sex composition that meet the Objective 3 criteria.

DATA COLLECTION

CAPTURE AND TAGGING

Effort and catch during drift gillnetting operations will be recorded on forms drafted by ADF&G and FOC. Weekly scheduling and effort will be determined by onsite staff in consultation with the project leaders (Richards and Etherton). Effort and catch will be recorded on the **Gillnet Effort Recording Form** (Appendix A1). River height to nearest 0.1 ft (from the USGS gauging station), temperature to nearest 1^oC (both at 0900 hours each day), shutdown times, and other comments will be recorded on these forms.

Data collected from each previously uncaptured Chinook salmon will be recorded on the **EVENT 1: Catch, Tag, and ASL Form** (Appendix A2) and includes the date and time caught, fish number, sex, length in mm MEF and POH, spaghetti tag and cinch tag numbers, condition (1: silver bright, 2: slight coloration, etc.), secondary/tertiary mark query, and any pertinent comments (wounds, sea lice, etc.). Under cumulative fish number, newly captured Chinook salmon will be sequentially numbered so that each fish has a unique fish number. Fish number is arbitrarily assigned to keep track of the total number of Chinook salmon inspected and released and is not to be confused with the spaghetti tag number. Each previously uncaptured Chinook salmon should have a row of data associated with it on the ASL form, *even if it is not tagged.* WE WILL NOT RECORD RECAPTURES ON THE EVENT 1: CATCH, TAG, AND ASL FORM. A list of recaptured fish should be kept at the end of the data book and should note date and time of recapture, spaghetti tag number, and condition of fish. The daily numbers of Chinook salmon caught during the Kakwan Point drift net operation and associated effort will be recorded on the

Catch-Effort and **Chinook Release Data** forms (Appendices A3 and A4) and reported to Douglas, Alaska and Whitehorse Yukon Territory staffs on a daily basis for the purpose of estimating inseason abundance.

Samplers will collect ASL data from each previously uncaptured Chinook salmon (all sizes) caught in the gillnets. Five scales will be collected per fish. Scales will be taken from the left side of the fish from the preferred area (3 taken 2–3 rows up from the lateral line and 1 inch apart, and 2 taken from 4–5 rows up 1 cm apart horizontally from the lower three scales) per the methods in Welander (1940). Scales will be affixed anterior side up on completely labeled gum cards (species, card number, locality = Stikine-Kakwan Point, Stat. code = 108-41-012, date, gear = drift gillnet, collectors = last names, remarks = weather, missing scales, etc.). Scale samples from 10 fish will be mounted on each gum card, and the scale card and scale numbers will be recorded on the **EVENT 1: Catch, Tag, and ASL Form**. It will be very important to completely label gum cards and forms so that the scales and data can be matched up in the aging lab. It will also be very important to keep the gum cards dry and free of dirt. Excessive moisture will dissolve the card's glue, which can lead to scales falling off the card or washing out of alignment. Running glue and dirt can also cover scales and cause unreadable imprints. *On wet weather days, scales will be placed in appropriately labeled slide holders, and transferred to gum cards later.* If for some reason scales are not collected from a fish, that column on the scale card will be crossed off in pencil and "no scales no. *X*" noted in the comments box. Recaptured fish will be released without taking scales.

In the event that a Chinook salmon with an adipose fin clip is netted, the fish will be sacrificed, sampled for ASL data, and tagged around the jaw with a cinch strap from the DCF's Mark, Age and Tag Laboratory (Tag Lab). For *each day fish are sampled*, the project biologist will fill out a **HATCHERY RACK AND ESCAPEMENT SURVEY** form provided by the Tag Lab. Heads with cinch straps will be air freighted to ADFG/Sport Fish, 802 3rd Street, Douglas, AK 99824, NOA: Philip Richards, 465-8114. Each head will be clearly labeled with information on capture site (Stikine River – Kakwan Point), date, species, sex, and length (mm MEF).

Sampling Chinook Salmon with Missing Adipose Fins

Data for documenting the fraction of the escapement missing adipose fins will be recorded each day adult sampling occurs. Sampling data collected at Kakwan Point, and Andrew Creek will be recorded by ADF&G on **HATCHERY RACK AND ESCAPEMENT SURVEY** forms; data collected from spawning grounds in Canada and the inriver fisheries will be recorded by FOC on forms provided by their tag lab (Secondary Objective 4). In addition to potential CWT-tagged Chinook salmon strays, we anticipate the return of age-1.1 to -1.5 Stikine River Chinook salmon from the 2006–2010 brood years that were CWT tagged in 2008–2012. Heads will be taken from all adult Chinook salmon that are missing adipose fins, and a uniquely-numbered cinch strap will be attached to each head. Capture site, date, sex, length (MEF), sample and head number (off the cinch strap) will be recorded by field staff on a Rite-n-Rain®[1] label, which will be included with each head shipped. Each head will be shipped to ADF&G in Douglas or FOC in Whitehorse (depending on whether the sampling site is in the U.S. or Canada). If shipment is delayed and refrigeration is unavailable, heads will be preserved with salt or borax. Each agency will ship the heads they collect and associated data forms, which will include the daily number inspected, to

[1] This and subsequent product names are included for a complete description of the process and do not constitute product endorsement.

their tag lab. A scale sample will also be taken from every adult Chinook salmon that is missing the adipose fin to verify brood year. Presence of spaghetti tag or secondary marks will also be recorded for each fish examined.

Sampling Chinook Salmon For Axillary Appendages

Axillary appendages will be sampled from each Chinook salmon tagged at Kakwan Point. Sampling protocols are given in Appendix A5. Duplicate axillary samples will be taken, one for ADF&G and one for FOC.

Spawning Ground Recoveries

All fish sampled on the spawning grounds (regardless of size), will be inspected for the three tagging marks, marks indicating the fish had been previously inspected at the recovery site, and adipose fin clips. Note that the first time a Chinook salmon is examined, it will be given a hole punch on the lower (ventral) left operculum (LLOP), after it has been sampled. It is extremely important that during recovery sampling we obtain an accurate count of the total number of fish inspected by size and a precise estimate of the age category, and of those, accurately detect any fish that were marked at Kakwan Point, or CWT-tagged. Sampling will be scheduled on the spawning grounds for times when most fish are still alive and the carcasses of dead fish are relatively fresh.

These steps will be followed for sampling each fish. First, each fish will be inspected for a lower left opercle punch (LLOP), which means the fish has already been inspected on the spawning grounds and should not be sampled again. On fish that do not have a LLOP, we will look for: 1) an upper left opercle punch (ULOP); 2) a spaghetti tag (or scar where a spaghetti tag may have once been affixed); and/or 3) a missing left axillary appendage (LAA) - any of these indicate the fish was tagged at Kakwan Point. After a fish is inspected for these marks, the lower left operculum will be punched and, if the fish is dead, the left side will be slashed with a knife as well to prevent double sampling. Note that in the event the spaghetti tag has fallen off, it will be vital that the other marks (tag scar, ULOP and/or LAA) are found. These marks may heal partially or fully, but because they are standardized, it should be fairly easy to detect them with careful inspection.

All recovery sampling information will be recorded on the **EVENT 2: Inspection, Recapture, and ASL Form** (Appendix A6). A data line of information will be recorded for each newly inspected fish. Date, fish number, sex, length (MEF and POH), and spaghetti tag number (if present) will be recorded. Age and AEC (age error code) columns will be left blank. Most importantly, we will record whether the upper opercle punch and axillary appendage clips are present (even for fish with a spaghetti tag) in the comments column. If a fish has a tag scar and no tag, "scar" will be recorded in place of the spaghetti tag number and the presence of the secondary or tertiary marks will be documented as well. All fish on the spawning grounds (outside of the Little Tahltan weir) will be sampled for scales (5, anterior side up), sex, and both lengths (MEF and POH). As before, scales will be mounted on gum cards, 10 fish per card, and the scale card and scale numbers will be recorded. If a carcass is so deteriorated that a length measurement is not possible, it will be assigned to a size category (<660 or ≥660 mm MEF), sex will be determined if possible, and a scale sample, even if it is taken from outside the preferred area, will be collected. The opercle punch should be visible in carcasses that are little more than a head, and if the head can be examined and size and sex determined, it is a valid and valuable sample.

All Chinook salmon that are missing adipose fins will be sacrificed. The head will be saved, a cinch strap tag will be affixed around the jaw, and the cinch number will be recorded. Scales, sex, and lengths from every fish without an adipose fin will also be taken. Heads will be clearly labeled with information on capture site (Little Tahltan River weir or carcass, Verrett River, Andrew Creek, etc.) date, species, sex, and length (mm MEF). *For each day fish are sampled* on the various spawning sites, project biologists will complete a Tag Lab **HATCHERY RACK AND ESCAPEMENT SURVEY** form, or a FOC tag lab form, depending on whether the sampling site is in the U.S. or Canada. Each head will be shipped to ADF&G in Douglas or FOC in Whitehorse, again depending on the sampling site.

INRIVER FISHERY RECOVERIES

Chinook salmon caught in the inriver fisheries will be sampled for scales, sex, length, and inspected for the three tagging marks as described in the previous section. In addition, a reward ($5 Can. for spaghetti tags) will be offered for each tag returned, which should ensure that all tags captured in the inriver fisheries are recovered. In addition to the Chinook salmon sampled for ASL data and tag recovery, 100% of the test fishery and a minimum of 50% of the inriver harvest will also be examined for missing adipose fins. All Chinook salmon without an adipose fin will be sacrificed, the head saved, a cinch strap tag affixed around the jaw, and the cinch number recorded. Scales, sex, and lengths from every fish without an adipose fin will also be taken. Each head will be clearly labeled with information on capture site (Stikine River - lower commercial fishery, etc.) date, species, sex, and length (MEF). Heads will be sent to FOC in Whitehorse.

Inseason Estimates of Passage

In order to honor Annex IV, Chapter1, Paragraph 3(a)(3)(x and xi) of the Pacific Salmon Treaty, which obliges the Parties to apportion their overall total allowable catch by historical weekly run timing, weekly fishery openings are announced based on weekly guideline harvests (PSC 2007). The preseason Chinook salmon forecast is used during weeks 18 through week 20. After week 20, inseason forecasts of total run size and allowable catch are used to assist in determining weekly fishing plans.

The Stikine Chinook Management Model and inseason mark-recapture estimates will be used to produce weekly inseason run projections starting around statistical week 21. The Stikine Chinook Management Model is based on the linear regression between weekly cumulative CPUE of large Chinook salmon observed at the Kakwan Point tagging site and total run size based on mark-recapture studies conducted in 1996–2012. There is a significant positive relationship between weekly cumulative CPUE and run size for most weeks (DerHovanisian and Etherton 2006). Inseason model estimates are typically available by statistical week 21 (around May 18). Mark-recapture estimates based on the cumulative ratio of tagged-to-untagged fish observed in the inriver commercial fishery are typically available by statistical week 22. The Canadian guideline harvests are derived from historical run timing data from the 2005–2012 inriver commercial fisheries and the 2000–2003 inriver test fisheries. The U.S. guidelines are derived from historical run timing in District 108 (1969–1973 and 2005–2010) and historical CPUE from the Kakwan Point tagging site, delayed 1 week (1996–2004) and the 2001–2003 average CPUE from the Canadian Chinook test fishery, delayed 2 weeks.

Accurate forecasts are necessary in order to plan and prosecute directed Chinook salmon fisheries prior to having inseason estimates of run strength. The preseason forecast of the terminal run size of large Chinook salmon is based on a sibling model that predicts age class run size using brood year performance. The run of the age-1.2 fish representing brood year *X* is used to estimate the run of age-1.3 fish the following year from brood year *X*. This process is performed for the two major age classes representing large Chinook salmon (i.e., age-1.2 predicts age-1.3; and age-1.3 predicts age-1.4) and is based on a simple linear regression using brood year information gathered since 1995. The performance of both the preseason forecasts of terminal run and inseason estimates from 2005 through 2012 are shown in Table 4.

Table 4.–Preseason and inseason forecasts of terminal run, and final estimates of large Chinook salmon terminal run to the Stikine River, and associated prediction errors , 2005–2012.

			Preseason forecast[b]		Inseason	
Statistical week	Date	Final estimate[a]	Point	Prediction error	Estimate	Prediction error
			2012			
21	20 May–26 May	31,228	40,800	31%	preseason	NA
22	27 May–22 June	31,228	40,800	31%	29,275	-6%
23	3 June–10 June	31,228	40,800	31%	20,950	-33%
24	11 June–16 June	31,228	40,800	31%	31,102	0%
25	17 June–23 June	31,228	40,800	31%	29,249	-6%
26	24 June–30 June	31,228	40,800	31%	33,629	8%
27	1 July–6 July	31,228	40,800	31%	25,331	-19%
28	7 July–13 July	31,228	40,800	31%	26,244	-16%
29	14 July–20 July	31,228	40,800	31%	27,300	-13%
			2011			
21	15 May–21 May	20,557	30,000	46%	preseason	NA
22	22 May–28 May	20,557	30,000	46%	preseason	NA
23	29 May–4 June	20,557	30,000	46%	18,327	-11%
24	5 June–11 June	20,557	30,000	46%	18,896	-8%
25	12 June–18 June	20,557	30,000	46%	18,963	-8%
26	19 June–25 June	20,557	30,000	46%	18,503	-10%
27	26 June–2 July	20,557	30,000	46%	21,206	3%
28	3 July–9 July	20,557	30,000	46%	22,716	11%
29	10 July–16 July	20,557	30,000	46%	22,716	11%
			2010			
21	16 May–22 May	23,356	22,900	-2%	preseason	NA
22	23 May–29 May	23,356	22,900	-2%	preseason	NA
23	30 may–5 June	23,356	22,900	-2%	22,300	-3%
24	6 June–12 June	23,356	22,900	-2%	19,715	-15%
25	13 June–19 June	23,356	22,900	-2%	20,968	-10%
26	20 June–26 June	23,356	22,900	-2%	20,646	-10%
27	27 June–3 July	23,356	22,900	-2%	21,924	-6%
28	4 July–10 July	23,356	22,900	-2%	21,924	-6%
29	11 July–17 July	23,356	22,900	-2%	21,924	-6%
			2009			
21	17 May–23 May	15,006	32,000	113%	preseason	NA
22	24 May–30 May	15,006	32,000	113%	preseason	NA
23	31 may–6 June	15,006	32,000	113%	25,500	68%
24	7 June–13 June	15,006	32,000	113%	25,200	65%
25	14 June–20 June	15,006	32,000	113%	24,700	65%
26	21 June–27 June	15,006	32,000	113%	24,700	57%
27	28 June – 4 July	15,006	32,000	113%	23,600	33%
28	5 July–11 July	15,006	32,000	113%	19,900	33%
29	12 July–18 July	15,006	32,000	113%	19,900	33%
			2008			
21	18 May–24 May	36,414	46,118	27%	preseason	NA
22	25 May–31 May	36,414	46,118	27%	48,000	32%
23	1 May–7 June	36,414	46,118	27%	44,000	21%

-continued-

Table 4.–Page 2 of 2.

Statistical week	Date	Final estimate[a]	Preseason forecast[b] Point	Preseason forecast[b] Prediction error	Inseason Estimate	Inseason Prediction error
			2008			
24	8 June–14 June	36,414	46,118	27%	44,000	21%
25	15 June–21 June	36,414	46,118	27%	50,000	37%
26	22 June–28 June	36,414	46,118	27%	38,000	4%
27	29 June–05 July	36,414	46,118	27%	38,000	4%
28	06 July–12 July	36,414	46,118	27%	38,000	4%
29	13 July–19 July	36,414	46,118	27%	38,750	6%
			2007			
21	15 May–22 May	40,546	37,355	-8%	preseason	NA
22	22 May–29 May	40,546	37,355	-8%	48,000	18%
23	19 May–5 June	40,546	37,355	-8%	44,000	9%
24	5 June–12 June	40,546	37,355	-8%	44,000	9%
25	12 June–19 June	40,546	37,355	-8%	50,000	23%
26	20 June–26 June	40,546	37,355	-8%	50,000	23%
27	27 June–03 July	40,546	37,355	-8%	45,000	11%
28	04 June–10 July	40,546	37,355	-8%	42,000	4%
29	11 July–17 July	40,546	37,355	-8%	44,000	9%
			2006			
21	16 May–22 May	66,952	60,600	-9%	69,300	4%
22	23 May–29 May	66,952	60,600	-9%	74,000	11%
23	30 May–5 June	66,952	60,600	-9%	65,800	-2%
24	6 June–12 June	66,952	60,600	-9%	64,000	-4%
25	13 June–19 June	66,952	60,600	-9%	70,000	5%
26	20 June–16 June	66,952	60,600	-9%	61,000	-9%
27	17 June–23 June	66,952	60,600	-9%	73,100	9%
28	24 June–30 June	66,952	60,600	-9%	67,300	1%
29	01 July–07 July	66,952	60,600	-9%	75,050	12%
			2005			
21	18 May–24 May	89,626	94,392	5%	preseason	NA
22	25 May–31 May	89,626	94,392	5%	71,711	-20%
23	1 June–7 June	89,626	94,392	5%	72,388	-19%
24	8 June–14 June	89,626	94,392	5%	72,966	-19%
25	15 June–21 June	89,626	94,392	5%	75,161	-16%
26	22 June–28 June	89,626	94,392	5%	75,309	-16%
27	29 June–05 July	89,626	94,392	5%	78,063	-13%
28	06 July–12 July	89,626	94,392	5%	NA	NA
29	13 July–19 July	89,626	94,392	5%	NA	NA

[a] Final estimates from 2005 to 2012 are germane to terminal run size (i.e., inriver run estimate at Kakwan Point plus harvest in the D108 terminal area).

[b] The official preseason inriver forecast of large Chinook salmon bound for the Stikine River in 2005 was 80,300. The official inriver forecast did not account for fish caught in the U.S. marine terminal fishery. The terminal run forecast should have been 94,392.

DATA REDUCTION

Field crew leaders will record and error check all data on field data forms, which will be kept up to date at all times (primary data capture). Kakwan Point catch-effort data will be relayed to Douglas daily for inseason abundance estimation purposes. Scale cards will be checked to ensure that scales are clean and mounted correctly, and that the cards are correctly labeled and matched up with the corresponding data forms. Scales that were placed in slide holders will be mounted on clean, dry cards every evening. The Kakwan Point scales will be pressed and aged in the scale-aging lab in Douglas. Fisheries and Oceans Canada project leader (Etherton) will do likewise for age data collected at the Little Tahltan River, Verrett River, and other spawning grounds, and from the inriver fisheries. Data collected by ADF&G and FOC will be entered into Excel™ spreadsheet files at the end of the season (secondary data capture). When input is complete, the data will be checked for nonsensical values (e.g., transposed lengths and invalid tag numbers) and against the original field data for transcription errors. When error checking is complete, ADF&G and FOC will exchange spreadsheet files. Copies of the data and a data map will be sent to Division of Sport Fish (DSF) Research and Technical Services (RTS) in Anchorage for archiving with the final report. Inspection data collected by ADF&G will be recorded on **HATCHERY RACK AND ESCAPEMENT SURVEY** forms, and completed forms will be sent to the Tag Lab, the local clearinghouse for all information on CWTs.

DATA ANALYSIS

Spawning Escapement And Inriver Run of Chinook Salmon $\geq$660 mm

Assuming the experiment does not need to be stratified by time/area, Chapman's modification of Petersen's method (Seber 1982:60) will be used to estimate spawning escapement of large Chinook salmon $\hat{N}_{LE}$ as:

$$\hat{N}_{LE} = \left[\hat{N}_{LR} = \frac{(\hat{M}+1)(C+1)}{(R+1)} - 1 \right] - \hat{N}_{LH} \qquad (1)$$

where:

$\hat{N}_{LR}$ = Estimated abundance of large Chinook salmon passing by Kakwan Point, i.e., inriver run size;

$\hat{M}$ = Estimated number of large (Kakwan Point) marked Chinook present for recovery in the inriver fisheries or on the spawning grounds;

C = Number of large adults inspected for (Kakwan Point) marks in the inriver fisheries and on the spawning grounds;

R = Number of large adults with (Kakwan Point) marks in samples taken in the inriver fisheries and the spawning grounds; and

$\hat{N}_{LH}$ = Estimate of inriver harvest of large adults above Kakwan Point, where $\hat{N}_{LH} = N_H \hat{p}_{LH}$, N_H is the (known) fish-ticket derived harvest, and $\hat{p}_{LH}$ is the estimated proportion of large fish in N_H (see section on ASL of harvest below).

The conditions for accurate use of this methodology are:

1a. all Chinook salmon have an equal probability of being marked at Kakwan Point; <u>or</u>

1b. all Chinook salmon have an equal probability of being inspected for marks; <u>or</u>

1c. marked fish mixed completely with unmarked fish in the population between events; <u>and</u>

2. there is no recruitment to the population between events; and

3. there is no tag-induced mortality; and

4. fish do not lose their marks and all marks are recognizable.

Conditions 1b and 1c will not be met for Chinook salmon in different stocks within the Stikine River. Inspection efforts will be restricted to the inriver gillnet fisheries, Little Tahltan River, Verrett River, and perhaps other large spawning concentrations. While the fishery targets a mix of stocks, fishing effort will not necessarily be constant, and probability of capture for stocks with different timing may differ. Therefore every spawner in the Stikine watershed above Kakwan Point will not have the same chance of being caught in the second sampling event. Because stocks within the Stikine River have different migratory patterns (Pahlke and Etherton 1999), and because fish within a stock that are marked on the first day will not mix with fish of the same stock marked on the last day of tagging before being sampled in the fishery, complete mixing of marked and unmarked fish is also impossible. Because these two conditions will not be satisfied, our chance for an unbiased estimate of spawning abundance of large fish solely depends on meeting the first condition (1a). For this reason, gillnets will be fished with consistent effort throughout the immigration past Kakwan Point. This relatively constant sampling effort will tend to equalize the probabilities of capture for all fish passing by Kakwan Point *regardless of when they pass* this site. Comparing marked fractions across inriver fisheries and tributaries using a chi-square test will test the assumption of proportional tagging. Such a test has shown that in most years all large salmon passing by Kakwan Point had an equal or near equal chance of being captured and marked with the proposed sampling protocols.

A battery of hypothesis tests will be used to determine if size-selective sampling occurred in the tributaries, inriver fisheries, or Kakwan Point (see Appendix B1). If size selective-sampling is indicated for Chinook salmon ≥660 mm, data will be stratified into size groups, and abundance estimated as the sum of stratum estimates. Such stratification will also be considered for the estimate of Chinook salmon <660 mm. Significant size-selective sampling has not been detected for large fish in most years. We may also use the models developed by Huggins (1989, 1991) to test for and, if necessary, incorporate size-selective sampling into the abundance estimates. Program MARK (White and Burnham 1999) will be used to fit and test these models.

The life history of Chinook salmon isolates those fish returning to the Stikine River as a 'closed' population (condition 2). Marked fish may have a greater mortality rate than do unmarked fish (condition 3) or may otherwise "emigrate" due to handling, moving back downstream (Bernard et al. 1999). Marked fish have been caught in marine commercial and U.S. recreational fisheries and have been observed in Andrew Creek, downriver from Kakwan Point. Independent programs run by DCF and DSF sample harvest in the U.S. commercial gillnet fishery and the recreational fishery near Petersburg. Marked fish recovered by these sampling programs, expanded for fractions of harvest sampled, will be censored from the experiment. Marked fish observed in Andrew and North Arm creeks will also be censored from the experiment. For Andrew Creek, the number of marked fish observed will be expanded by the estimated sampling fraction (estimated escapement/total fish examined for marks). The estimated escapement for Andrew Creek will be derived from a historical relationship between peak aerial survey count and escapement through a weir. The escapement to North Arm Creek is small (peak count average = 36 large fish 1993–2003, Pahlke 2005) and to date, no tags have been observed in North Arm Creek during the annual DCF foot survey. Any tags encountered in North Arm Creek will be individually censored from the experiment. The estimated number of marked fish that reach the inriver fisheries and upriver spawning grounds ($\hat{M}$) will be the number of uncensored marked fish remaining in the experiment. The number of fish censored in 2012 as a result of recoveries in the U.S. gillnet and sport fisheries and in Andrew and North Arm creeks was 5 (3 from the District 108 commercial gillnet fishery and 2 from the sport fishery). We believe we successfully censor the large majority of tags applied to fish that do not sustain an upstream migration, i.e., those not susceptible to capture in the recapture events upstream. In 2005, about 3% of radio-tagged fish were tracked as known 'down-streamers' (i.e., located in either the U.S. gillnet District 108 harvest, the U.S. sport harvest, or Andrew Creek; 11 were tracked to these locations out of 369 radio tags deployed). The number of censored marks in the 2012 mark-recapture study was about 1% (5 out of 390 applied). Each marked fish will receive a numbered spaghetti tag, a secondary mark, and a tertiary mark, meaning marks will be recognizable during the second event sampling and any spaghetti tag loss will be accounted for in the analysis (condition 4).

An estimate of the variance for $\hat{N}_{LR}$ will be obtained through bootstrapping (Efron and Tibshirani 1993) according to methods in Buckland and Garthwaite (1991). The estimated $\hat{N}_{LR}$ in the experiment will be divided into capture histories (Table 5) to form an empirical probability distribution (epd). A bootstrap sample of size $\hat{N}_{LR}$ will be drawn from the epd with replacement. From the resulting collection of resampled capture histories, R^*, C^*, $\hat{M}^*$, and $\hat{N}^*_{LR}$ will be calculated. A large number (B) of bootstrap samples will be so drawn. The approximate variance will be calculated as:

$$var(\hat{N}_{LR}) = \frac{\sum_{b=1}^{B} (\hat{N}^*_{LRb} - \hat{\bar{N}}^*_{LR})^2}{B-1} \tag{2}$$

where $\hat{\bar{N}}^*_{LR}$ is the average of the $\hat{N}^*_{LRb}$. Confidence intervals will be obtained using the percentile method.

With respect to the variance of $\hat{N}_{LE}$, sample sizes used to estimate the proportion of large fish harvested ($\hat{p}_{LH}$) are typically large (over 1,000 in 2010, 2011 and 2012) and $\hat{p}_{LH}$ has been far from the worse-case scenario of 0.5. A typical relative 95% precision for the estimate of $\hat{N}_{LH} = \hat{p}_{LH} N_H$ is less than 2%. The parameter $\hat{N}_{LH}$ is therefore treated as a constant and:

$$var(\hat{N}_{LE}) = var(\hat{N}_{LR}) \tag{3}$$

Table 5.–Capture histories for Chinook salmon in the Stikine River mark-recapture experiment, 2013.

1. Marked but censored in U.S. marine recreational fishery.
2. Marked but censured in U.S. marine commercial fisheries.
3. Marked but censured in Andrew and North Arm creeks.
4. Marked and not sampled on spawning grounds or inriver fisheries.
5. Marked and recaptured on spawning grounds or inriver fisheries.
6. Not marked but captured on spawning grounds and inriver fisheries.
7. Not marked and not sampled on spawning grounds and inriver fisheries.

Spawning Escapement And Inriver Run of Chinook Salmon <660 mm

The spawning escapement of Chinook salmon <660 mm MEF will be estimated separately from that of large fish. The preferred estimate of spawning escapement of fish <660 mm will be calculated as in Equations 1 through 3 above, substituting large fish by fish <660 mm.

If we mark, inspect, and recapture too few fish <660 mm, such that the estimate of fish <660 mm past Kakwan Point has insufficient precision (estimated relative precision >50%), then we will base the spawning escapement estimate for fish <660 mm on the spawning escapement estimate of large fish and the proportion of large fish in the spawning ground samples:

$$\hat{N}_{<660E} = \hat{N}_{LE}\left(\frac{1}{\hat{p}_{LE}} - 1\right) \tag{4}$$

where $\hat{p}_{LE}$ is the estimated fraction of large fish in the spawning population, obtained from spawning ground ASL sampling; this proportion is typically based on a greater sample size than that on which spawning ground age-sex composition is based; many fish are measured for length but do not contribute to the age-sex composition.

The variance of the estimate of the escapement of fish <600 mm will be estimated (Goodman 1960):

$$\text{var}(\hat{N}_{<660E}) = \text{var}(\hat{N}_{LE})\left[\frac{1}{\hat{p}_{LE}} - 1\right]^2 + \hat{N}_{LE}^{\,2}\,\text{var}\left(\frac{1}{\hat{p}_{LE}}\right) - \text{var}\left(\frac{1}{\hat{p}_{LE}}\right)\text{var}(\hat{N}_{LE}) \tag{5}$$

where by the delta method,

$$\text{var}\left(\frac{1}{\hat{p}_{LE}}\right) \approx \left(\frac{1}{\hat{p}_{LE}}\right)^4 \frac{\hat{p}_{LE}(1-\hat{p}_{LE})}{n_E - 1} \tag{6}$$

and n_E is the number of fish of all sizes in the spawning ground sample. Confidence intervals will be derived via simulation, where for each bootstrap realization of the abundance of large fish, a binomial random variable will be drawn (~binomial (trials = number of fish inspected on the spawning grounds, probability $= \hat{p}_{LE}$)) and a simulated $\hat{p}_{LE}$ produced. A simulated $\hat{N}_{<660E}$ will be calculated and confidence intervals derived using the percentile method.

The estimated inriver run of Chinook salmon <660mm at Kakwan Point will be estimated as:

$$\hat{N}_{<660R} = \hat{N}_{<660E} + \hat{N}_{<660H} \tag{7}$$

where $\hat{N}_{<660H} = N_H - \hat{N}_{LH}$, and with variance (ignoring $\text{var}(\hat{N}_{LH})$):

$$\text{var}(\hat{N}_{<660R}) = \text{var}(\hat{N}_{<660E}) \tag{8}$$

Spawning Escapement And Inriver Run of All Chinook Salmon

Total inriver run at Kakwan Point will be estimated:

$$\hat{N}_R = \hat{N}_{<660R} + \hat{N}_{LR} \tag{9}$$

with variance estimated as:

$$\text{var}(\hat{N}_R) = \text{var}(\hat{N}_{LR})\left[\frac{1}{\hat{p}_{LE}}\right]^2 + (\hat{N}_{LR} - \hat{N}_{LH})^2 \text{ var}\left(\frac{1}{\hat{p}_{LE}}\right) - \text{var}\left(\frac{1}{\hat{p}_{LE}}\right)\text{var}(\hat{N}_{LR}) \quad (10)$$

Total spawning escapement will be estimated as:

$$\hat{N}_E = \hat{N}_{<660E} + \hat{N}_{LE} \quad (11)$$

with estimated variance (harvest is known):

$$\text{var}(\hat{N}_E) = \text{var}(\hat{N}_R) \quad (12)$$

Weir Count to Spawning Escapement Expansion Factor

An expansion factor to relate the count at the Little Tahltan River weir of large fish (W_L) to spawning escapement of large fish in 2013 will be estimated by:

$$\hat{\pi} = \hat{N}_{LE} W_L^{-1} \quad (13)$$

$$var(\hat{\pi}) = var(\hat{N}_{LE}) W_L^{-2} \quad (14)$$

Large fish can be visually distinguished from smaller fish as they pass through the weir with negligible error, making W_L a constant,

Age, Sex, and Length Composition of Harvest

The proportion of the harvest of a given size category *i* composed of age *j* will be estimated as a binomial variable from fish sampled from the fishery:

$$\hat{p}_{ijH} = \frac{n_{ijH}}{n_{iH}} \quad (15)$$

$$\text{var}[\hat{p}_{ijH}] = \frac{\hat{p}_{ijH}(1 - \hat{p}_{ijH})}{n_{iH} - 1} \quad (16)$$

where n_{ijH} is the number of Chinook salmon of age *j* in the sample of size category *i*, n_{iH} , taken from the fishery.

The number of fish taken in the fishery by age will be estimated as:

$$\hat{N}_{jH} = \sum_i \hat{p}_{ijH} \hat{N}_{iH} \quad (17)$$

, with variance estimated as:

$$\text{var}(\hat{N}_{jH}) = \sum_i \text{var}(\hat{p}_{ijH}) \hat{N}_{iH}^{\ 2} \quad (18)$$

Recall that $\hat{N}_{iH}$ is estimated as the product of the known harvest of all fish and the estimated proportion of fish of size *i* in the harvest (i.e., $N_H \hat{p}_{iH}$). As mentioned earlier, the number of fish used to estimate $\hat{p}_{iH}$ is typically very large (larger than that used to estimate age and sex) and its variance is considered negligible, hence the treatment of $\hat{N}_{iH}$ as a constant in Equation 18.

Estimates for sex and length will be calculated similarly. Estimates of mean length-at-age and their estimated variances will be calculated with standard sample summary statistics (Cochran 1977).

Age, Sex, and Length Composition of - Spawning Escapement

The proportion of the spawning escapement population composed of age *j* in size category *i* (large or small) will be estimated as a binomial variable from fish sampled on the spawning grounds:

$$\hat{p}_{ijE} = \frac{n_{ijE}}{n_{iE}} \tag{19}$$

$$\text{var}[\hat{p}_{ijE}] = \frac{\hat{p}_{ijE}(1 - \hat{p}_{ijE})}{n_{iE} - 1} \tag{20}$$

where n_{ijE} is the number of Chinook salmon of age *j* in size category *i* in the aged sample n_{iE} taken on the spawning grounds.

Numbers of spawning fish of age *j* in the spawning escapement will be estimated as the summation of products of estimated age composition and estimated spawning abundance within size category *i*:

$$\hat{N}_{jE} = \sum_i \left(\hat{p}_{ijE}\hat{N}_{iE}\right) \tag{21}$$

where $\hat{N}_{iE}$ is the spawning abundance within size category *i*.

Variance of individual components of Equation 21 will be estimated according to Goodman(1960):

$$\text{var}(\hat{p}_{ijE}\hat{N}_{iE}) = \text{var}(\hat{N}_{iE})\hat{p}_{ijE}^2 + \text{var}(\hat{p}_{ijE})\hat{N}_{iE}^2 - \text{var}(\hat{N}_{iE})\,\text{var}(\hat{p}_{ijE}) \tag{22}$$

If sufficient tags are recovered from Chinook salmon ≤660 mm, such that an independent estimate of $\hat{N}_{<600E}$ is obtained, the variance of $\hat{N}_{jE}$ will be estimated by $\sum_i \text{var}(\hat{p}_{ijE}\hat{N}_{iE})$.

If insufficient tags are recovered from fish <600mm such that the proportionality method is used, there will be dependence between the $\hat{p}_{ijE}\hat{N}_{iE}$ terms for *i* <660 mm and *i* = L in Equation 21, so the variance of $\hat{N}_{jE}$ will be estimated by simulation. Stochastic components of the simulation will be:

$N_{LR}^* \sim N(\hat{N}_{LR}, \text{var}(\hat{N}_{LR}))$,

$N^*_{LE} = N^*_{LR} - \hat{N}_{LH}$,

$p^*_{LE} \sim Bin(n_E, \hat{p}_{LE}) / n_E$,

$N^*_{<660E} = N^*_{LE}\left(\frac{1}{p^*_{LE}} - 1\right)$,

$N^*_{<660R} = N^*_{<660E} + \hat{N}_{<660H}$, and

$\underline{p}^*_{ijE} \sim multinomial(n_{iE}, \underline{\hat{p}}_{ijE})$.

Equations through 21 will be used to generate simulated values of $\hat{N}_{jE}$, and its sample variance calculated.

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

$$\hat{p}_{jE} = \frac{\hat{N}_{jE}}{\hat{N}_E} \tag{23}$$

Variance of $\hat{p}_{jE}$ will be approximated according to the procedures in Seber (1982, p. 8–9):

$$\mathrm{var}(\hat{p}_{jE}) = \frac{\sum_i \left(\mathrm{var}(\hat{p}_{ijE})\hat{N}^2_{iE} + \mathrm{var}(\hat{N}_{iE})(\hat{p}_{ijE} - \hat{p}_{jE})^2\right)}{\hat{N}^2_E} \tag{24}$$

If insufficient tags are recovered from fish <600mm such that the proportionality method is used, the variance of $\hat{p}_{jE}$ will be estimated through simulation.

Sex and age-sex composition for the spawning population and associated variances will also be estimated with the equations above by first redefining the binomial variables in the 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 $\sum_j \sum_k \hat{p}_{jk} = 1$. Sex composition from samples collected on the spawning grounds will be more reliable than those collected from the tagging and fishery samples because of the enhanced physiological development of the former.

Estimates of mean length at age and their estimated variances will be calculated with standard sample summary statistics (Cochran 1977).

Age and Sex Composition of Inriver Run

Inriver run by age category *j* will be estimated as

$$\hat{N}_{jR} = \hat{N}_{jE} + \hat{N}_{jH} \tag{25}$$

with variance estimated as:

$$\mathrm{var}(\hat{N}_{jR}) = \mathrm{var}(\hat{N}_{jE}) + \mathrm{var}(\hat{N}_{jH}) \tag{26}$$

SCHEDULE AND DELIVERABLES

Field activities for tagging Chinook salmon at Kakwan Point will begin in early May and extend through mid July. Field activities for recovery of tagged Chinook at the Little Tahltan River weir will begin in late June. Recovery efforts on Verrett River Chinook will commence in early August and finish approximately mid August. Andrew and North Arm creeks and other accessible spawning areas will be surveyed from early August to mid August to recover tags, inspect fish for missing adipose fins, and to collect age, sex, and size data. Tag collection will occur throughout the duration of the Stikine River commercial and Aboriginal fisheries. At this juncture, personnel to measure fish (sex, size, and age) and observe for secondary and tertiary marks in the aboriginal fishery may not be available. Data on tagging from Kakwan Point will be entered and edited in Juneau by ADF&G personnel and distributed to the other principal investigators by 31 August 2013. Data from the recovery locations will be sent to Philip Richards in Juneau by 31 October 2013, and then entered into Excel™ spreadsheets, edited, and distributed for any final editing by 30 January 2014 to FOC. A draft report will be written in Juneau by ADF&G by 30 April 2014 and distributed for editing and further writing to FOC. Changes to the report will be submitted by FOC to ADF&G by 1 July 2014 and the final report will be submitted for final peer review by 1 September 2014.

RESPONSIBILITIES

I. Agency Responsibilities

A. ADF&G. Will plan project in cooperation with FOC. Will write operational plan with FOC. Will provide equipment for all aspects of tagging, room and board at Kakwan Point, and other operating supplies. Will summarize all tagging data from Kakwan Point operations in spreadsheets and provide to FOC. Will survey Andrew Creek escapement. Will coalesce recovery data from recovery locations. Will perform analysis and take responsibility for analysis of data and first draft of report. Will provide final data and draft of report for review to FOC.

B. FOC. Will assist in planning of project. Will provide core staff to tag at Kakwan Point and will recover tags from Little Tahltan and Verrett rivers. Will cover the costs and logistics associated sampling the inriver commercial fishery. Will cover the costs and logistics associated with tag recoveries and tag rewards to Canadian, commercial, and Aboriginal fishers ($5CAN/spaghetti). Will provide tagging, recovery, and age data to ADF&G (Sport DSF) by 31 October 2013. Will review data, provide input into report, write sections regarding recovery and serve as co-author.

II. U.S. Personnel Responsibilities

Troy Jaecks, FBII, Project Leader. In concert with Philip Richards, and Peter Etherton, sets up all aspects of project, including planning, budget, sample design, permits, equipment, personnel, and training. Assists in supervising Kakwan Point operations and assists with supervision of recovery. Coalesces, edits, analyzes, and reports data; assists with fieldwork; arranges logistics with field crew. Takes lead role in analysis and first draft of report.

Philip Richards, FBIII. Will oversee and assist with all aspects of the project including planning, budget, sample design, permits, equipment, and supervising field operations. Coalesces, edits, analyzes and reports data; assists with fieldwork.

Ed Jones, Salmon Research Coordinator. This position is responsible for general oversight of this project and the Chinook stock assessment program in the region. Reviews project planning, operational plans and technical reports.

Scott McPherson, Fisheries Scientist. This position functions as senior technical advisor, may assist in project planning, operational plans and technical reports.

David Evans, Biometrician III. Provides input to and approves sampling design. Reviews operational plan and provides biometric details. Reviews and assists with data analysis and final report.

Stephen Todd, FTIII. This position is responsible for supervising one portion of the field tagging program. Will coordinate schedules with FOC/Tahltan crew and share responsibility for all aspects of field operations, including safe operation of riverboats, and other equipment, tagging, data collection, and general field camp duties. Will assume lead role in equipment and camp maintenance.

Vacant, FTII. Will be responsible for assisting in all aspects of field operations, including safe operation of riverboats, and other equipment, tagging, data collection, and general field camp duties. Will assist in equipment and camp maintenance. Will work closely with Tahltan crew to fish in the most efficient manner possible.

II. Canadian Personnel Responsibilities

Peter Etherton, Senior Fishery Technician. In concert with Troy Jaecks, Philip Richards, and Stephen Todd, assist in all aspects of the program, including: tag application, tag recovery, and report preparation. Will be responsible for scheduling Canadian staff at both the tagging and recovery sites. Will participate in both the tagging and recovery component of the program. Will arrange and participate in meetings with Canadian, commercial, and Aboriginal fishers. Will provide recovery data to ADF&G. Will review data, provide input into report, write sections regarding recovery and serve as co-author.

Kyle Inkster, Tahltan Fisheries Technician. This position is responsible for supervising the other portion of the field tagging program. Will coordinate schedules with the ADF&G crew and share responsibility for all aspects of field operations, including safe operation of riverboats, and other equipment, tagging, data collection, and general field camp duties. Will assist in equipment and camp maintenance.

Kerry Carlick, Tahltan Fisheries Technician. Will be responsible for assisting in all aspects of field operations, including safe operation of riverboats, and other equipment, tagging, data collection, and general field camp duties. Will assist in equipment and camp maintenance. Will work closely with ADF&G crew to fish in the most efficient manner possible.

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APPENDIX A

Appendix A1.–Gillnet effort recording form.

Location ____________________________ Date _______________ Page_______________

Water Temp_________at _________Hr _ Water Depth____________at ____ ______Hr _

Water Comments ____________________ Weather Comments_________________________

Gear Description ____________________ Crew ____________________________________

Drift/ Set #	Start	Stop	Minutes Fished	Cumulative Minutes	Large (≥660 mm MEF) Chinook	Small-medium (<660 mm MEF) Chinook	Comments: other species, snags. Note, ad clips and Chinook caught but not tagged
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
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26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
Daily Totals							

Appendix A2.–Event 1: catch, tag, and age-sex-length form.

Location ________________________ Page______________________

Stream Code 108-41-012 Year_____________________

Species __________________________ Gear Type __________________

Cum Fish #	Date	Time Caught	Sex	Card #	Scale #	MEF	POH	Age FW	Age SW	AEC	Spag Tag #	Ad Clip	Cinch Tag #	Cond.	Comments: rel'd w/o LAA or ULOP? Note lice, scars, bleeding, morts
					1										
					2										
					3										
					4										
					5										
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Condition (Cond.): 1 = bright; 2 = slight coloration; 3 = obvious coloration and the onset of sexual dimorphism; 4 = same as 3 but gametes released upon capture

Appendix A3.–Catch-effort form.

RECORD AND PHONE IN DATA FROM SHADED CELLS

Date	ADFG, minutes	DFO, minutes	Total minutes	Total hours	Large Catch	Large Tagged	Cum Large Catch	Cum Large Tagged	Jack Catch	Jack Tagged	Cum Jack Catch	Cum Jack Tagged	Large CPUE

Appendix A4.–Chinook release data form.

Year: 2013 Page _____ of ______

Site: Kakwan Pt.

STAT WEEK	DATE	Large Chinook, ≥660 mm MEF			Small-Med. Chinook, <660 mm MEF		Comments (missing tags)
		Tag Count	Tags Out: Beginning Number	Tags Out: Ending Number	Tag Count	Tags Out: Tag Numbers	
18	May 1	K					
		S					
18	May 2	K					
		S					
19	May 3	K					
		S					
19	May 4	K					
		S					
19	May 5	K					
		S					
19	May 6	K					
		S					
19	May 7	K					
		S					
19	May 8	K					
		S					
19	May 9	K					
		S					
20	May 10	K					
		S					
20	May 11	K					
		S					
20	May 12	K					
		S					

Appendix A5.–Tissue sampling instructions from the Gene Conservation Laboratory.

Stikine River Chinook Salmon Genetic Collection Procedures

Non-lethal sampling of Finfish Tissue for DNA Analysis

ADF&G Gene Conservation Lab, Anchorage

I. General Information

We use axillary process samples from individual fish to determine the genetic characteristics and profile of a particular run or stock of fish. This is a non-lethal method of collecting tissue samples from adult fish for genetic analysis. The most important thing to remember in collecting samples is that **only quality tissue samples give quality results**. If sampling from carcasses: tissues need to be as "fresh" and as cold as possible and recently moribund, do not sample from fungal fins.

Sample preservative: Ethanol (ETOH) preserves tissues for later DNA extraction without having to store frozen tissues. Avoid extended contact with skin.

II. Sample procedure:

1. Tissue type: Axillary process, clip axillary process from each fish (see attached print out).
2. Data to record: Record each vial number to paired data information.
3. Prior to sampling, fill the tubes half way with ETOH from the squirt bottle. Fill only the tubes that you will use for a particular sampling period.
4. To avoid any excess water or fish slime in the vial, wipe the axillary process dry prior to sampling. Using the dog toe nail clipper or scissors, clip off axillary process (**1/2 -1" max**) to fit into the cryovial.
5. Place axillary process into ETOH. The tissue/ethanol ratio should be **slightly less than 1:3** to thoroughly soak the tissue in the buffer.
6. Top up tubes with ETOH and screw cap on securely. Invert tube twice to mix ETOH and tissue. Periodically, wipe the dog toe nail clippers or scissor blade so not to cross contaminate samples.
7. Discard remaining ethanol from the 500 ml bottle before returning samples. **Tissue samples must remain in 2ml ethanol** after sampling. HAZ-MAT paperwork will be required for return shipment. Store vials containing tissues at cool or room temperature, away from heat in the white sample boxes provided. In the field: keep samples out of direct sun, rain and store capped vials in a dry, cool location. Freezing not required.

III. Supplies included with sampling kit:

1. (1) – Dog toe nail clipper - used for cutting the axillary process
2. (1) – Scissors can be used to cut a portion axillary process – if clippers don't work for your crew
3. Cryovial- a small (2 ml) plastic vial, pre-labeled.
4. Caps – with or without gasket to prevent evaporation of ETOH.
5. Cryovial rack- white plastic rack with holes for holding cryovials while sampling
6. Ethanol (ETOH) – in (2) 500 ml plus (1) – 125 ml Nalge bottle
7. Squirt bottle – to fill or "top off" each cryovial with ETOH
8. Paper towels – use to blot any excess water or fish slime off axillary process
9. Printout of sampling instructions
10. (3) – three pair of lab gloves (size large)
11. Laminated "return address" label

IV. Shipping: HAZMAT paperwork is required for return shipment of these samples and is included in the kit.

<u>Ship samples to:</u> ADF&G – Genetics	Lab staff: 1-907-267-2247
333 Raspberry Road	Nick Decovich: 1-907-267-2239

Axillary process tissue for Genetic Stock Identification (GSI)

Axillary process or "spine" located above the pelvic fin.

Appendix A6.–Event 2: inspection, recapture, and age-sex-length form.

Location ______________________ Page ______________________

Stream Cod______________________ Year ______________________

Species ______________________ Gear Type ________________

Cum Fish #	Date	Sex	Card #	Scale #	MEF	POH	Age FW	Age SW	AEC	Spag Tag #	Ad Clip	Cinch Tag #	Cond.	Comments: LAA and/or ULOP present, **ULOP shape**?
				1										
				2										
				3										
				4										
				5										
				6										
				7										
				8										
				9										
				10										
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Condition (Cond.): PS = pre-spawn, LPS = live post-spawn, D = dead; Stream Code: Verrett River = 108-70-080, Little Tahltan R. = 108-80-120, Andrew Creek = 108-40-020,Stikine R. Fishwheels to Talbot (lower inriver TF/CF) = 108-70-0;

APPENDIX B

Appendix B1.–Detection of size or sex selective sampling during a 2-sample mark recapture experiment and its effects on estimation of population size and population composition.

Size selective sampling: The Kolmogorov-Smirnov two sample test (Conover 1980) is used to detect significant evidence that size selective sampling occurred during the first or second sampling events. The second sampling event is evaluated by comparing the length frequency distribution of all fish marked during the first event (M) with that of marked fish recaptured during the second event (R), using the null test hypothesis of no difference. The first sampling event is evaluated by comparing the length frequency distribution of all fish inspected for marks during the second event (C) with that of R. A third test, comparing M and C, is conducted and used to evaluate the results of the first two tests when sample sizes are small. Guidelines for small sample sizes are <30 for R and <100 for M or C.

Sex selective sampling: Contingency table analysis (Chi^2-test) is generally used to detect significant evidence that sex selective sampling occurred during the first of second sampling events. The counts of observed males to females are compared between M&R, C&R, and M&C as described above, using the null hypothesis that the probability that a sampled fish is male or female is independent of sample. When the proportions by gender are estimated for a sample (usually C), rather an observed for all fish in the sample, contingency table analysis is not appropriate and the proportions of females (or males) are compared between samples using a two-sample test (e.g. Student's t-test).

M vs. R	**C vs. R**	**M vs. C**
Case I:		
Fail to reject H_o	Fail to reject H_o	Fail to reject H_o

There is no size/sex selectivity detected during either sampling event.

Case II:

Reject H_o	Fail to reject H_o	Reject H_o

There is no size/sex selectivity detected during the first event but there is during the second event sampling.

Case III:

Fail to reject H_o	Reject H_o	Reject H_o

There is no size/sex selectivity detected during the second event but there is during the first event sampling.

Case IV:

Reject H_o	Reject H_o	Reject H_o

There is size/sex selectivity detected during both the first and second sampling events.

Case V

Fail to reject H_o	Fail to reject H_o	Reject H_o

Sample sizes and powers of tests must be considered in Case V:

A. If sample sizes for M vs. R and C vs. R tests are not small and sample sizes for M vs. C test are very large, the M vs. C test is likely detecting small differences that have little potential to result in bias during estimation. *Proceed as for Case 1*.

B. If a) sample sizes for M vs. R are small, b) the M vs. R p-value is not large (~0.20 or less), and c) the C vs. R sample sizes are not small and/or the C vs. R p-value is fairly large (~0.30 or more), the rejection of the null in the M vs. C test was likely the result of size/sex selectivity during the second event which the M vs. R test was not powerful enough to detect. May proceed as for *Case I* but *Case II* is the recommended, conservative interpretation.

C. If a) sample sizes for C vs. R are small, b) the C vs. R p-value is not large (~0.20 or less), and c) the M vs. R sample sizes are not small and/or the M vs. R p-value is fairly large (~0.30 or more), the rejection of the null in the M vs. C test was likely the result of size/sex selectivity during the first event which the C vs. R test was not powerful enough to detect. May proceed as for *Case I* but *Case III* is the recommended, conservative interpretation.

D. If a) sample sizes for C vs. R and M vs. R are both small, and b) both the C vs. R and M vs. R p-values are not large (~0.20 or less), the rejection of the null in the M vs. C test may be the result of size/sex selectivity during both events which the C vs. R and M vs. R tests were not powerful enough to detect. May proceed as for *Cases I, II, or III* but *Case IV* is the recommended, conservative interpretation.

Case I. Abundance is calculated using a Petersen-type model from the entire data set without stratification. Composition parameters may be estimated after pooling length, sex, and age data from both sampling events.

Case II. Abundance is calculated using a Petersen-type model from the entire data set without stratification. Composition parameters may be estimated using length, sex, and age data from the first sampling event without stratification. If composition is estimated from second event data or after pooling both sampling events, data must first be stratified to eliminate variability in capture probability (detected by the M vs. R test) within strata. Composition parameters are then estimated within strata, and weighted by stratified Petersen abundances, to yield overall composition estimates (see formulae below)

Case III. Abundance is calculated using a Petersen-type model from the entire data set without stratification. Composition parameters may be estimated using length, sex, and age data from the second sampling event without stratification. If composition is estimated from first event data or after pooling both sampling events, data must first be stratified to eliminate variability in capture probability (detected by the C vs. R test) within strata. Composition parameters are then estimated within strata, and weighted by stratified Petersen abundances, to yield overall composition estimates (see formulae below)

Case IV. Abundance is calculated using a Petersen-type model for each stratum, and estimates are summed across strata to estimate overall abundance. Composition parameters may be estimated within the strata as determined above, but only using data from sampling events where stratification has eliminated variability in capture probabilities within strata. If data from both sampling events are to be used, further stratification may be necessary to meet the condition of capture homogeneity within strata for both events. Overall composition parameters are estimated by combining stratum estimates weighted by estimated stratum abundance.

If stratification by sex or length is necessary prior to estimating composition parameters, an overall composition parameters (p_k) is estimated by combining within stratum composition estimates using:

$$\hat{p}_k = \sum_{i=1}^{j} \frac{\hat{N}_i}{\hat{N}_\Sigma} \hat{p}_{ik} \text{, and} \quad (1)$$

$$\hat{V}[\hat{p}_k] \approx \frac{1}{\hat{N}_\Sigma^2} \left(\sum_{i=1}^{j} \hat{N}_i^2 \hat{V}[\hat{p}_{ik}] + \left(\hat{p}_{ik} - \hat{p}_k \right)^2 \hat{V}[\hat{N}_i] \right) \quad (2)$$

where: j = the number of sex/size strata;

$\hat{p}_{ik}$ = the estimated proportion of fish that were age or size k among fish in stratum i;

$\hat{N}_i$ = the estimated abundance in stratum i;

$\hat{N}_\Sigma$ = $\sum_{i=1}^{j} \hat{N}_i$