Regional Operational Plan No. ROP.SF.1J.2022.16

Operational Plan: Spawning Escapement of Chinook Salmon in the Stikine River, 2019–2021

by

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July 2022

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

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Signature/Title Page

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ABSTRACT

The spawning escapement of large (≥660 mm MEF) Chinook salmon Oncorhynchus tshawytscha above the U.S.-Canada border will be estimated yearly from 2019-2021 in the Stikine River, near Wrangell, Alaska. A modified Petersen 2-event mark-recapture project will be conducted using drift gillnets to mark Chinook salmon in the first event, and collection of samples in the Canadian commercial fishery, Little Tahltan River video weir, and on the spawning grounds will serve as the second event. Age, sex and length of both the inriver run and spawning escapement of Chinook salmon will also be estimated. The Alaska Department of Fish and Game and Fisheries and Oceans Canada use these data to make terminal and regional management decisions, and the Pacific Salmon Commission uses the data for coastwide management and stock assessment through the Chinook Technical Committee.

Keywords: Chinook salmon, Oncorhynchus tshawytscha, adult production, abundance-based management, Petersen estimator, coded wire tag, marine survival, exploitation, mark-recapture, inriver run, escapement, total run, age composition, Stikine River

PURPOSE

The primary goals of this study are to estimate the annual spawning escapement of large (≥660 mm mid eye to fork of tail length (MEF)) Chinook salmon *Oncorhynchus tshawytscha* above the U.S.-Canada border in the Stikine River from 2019 to 2021, and to estimate the age, sex and length composition of both the inriver run and spawning escapement. The Alaska Department of Fish and Game (ADF&G) and Department of Fisheries and Oceans Canada (DFO) use 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).

The Stikine River is 1 of the 12 stocks chosen by the ADF&G as a Chinook salmon indicator stock and will serve as an existing and continuing source of data regarding Chinook trends in the state of Alaska. Age-structured production models that are widely used to understand a stock's dynamics require information about processes like recruitment, mortality and abundance. To better understand these processes, the ADF&G, Region 1, Division of Sport Fish (DSF) will continue to estimate the abundance of large Chinook salmon in the Stikine River.

The Stikine River is one of 50 Chinook escapement indicator stocks assessed annually by the PSC CTC to determine stock status and other requirements of the U.S./Canada Pacific Salmon Treaty (PST). Chapter 2 of the 1999 PST 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 estimate the marine harvest and smolt abundance (Courtney et al. *Unpublished*), and methods were developed for preseason and inseason terminal run estimation. The PSC CTC estimates coastwide Chinook salmon abundance through analysis of escapement, harvest, age structure, and exploitation rates derived from CWT recoveries. At present, the Stikine River Chinook salmon stock is not included in the PSC Chinook model; however, it will be incorporated into a new version of the PSC Chinook model.

BACKGROUND

The Stikine River is one of the two largest producers of Chinook salmon in northern British Columbia and Southeast Alaska (Pahlke 1995), with the other being the Taku River. Chinook salmon from the Stikine River are harvested in US troll and gillnet commercial fisheries, as well as in sport and federal subsistence fisheries. Harvest also occurs in Canadian inriver commercial, sport and aboriginal fisheries. 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 considered depleted; as a result, in 1978, the U.S. spring gillnet fishery for Chinook salmon was suspended. Annual incidental harvests, taken in the District 106 and 108 gillnet sockeye salmon *Oncorhynchus nerka* fisheries, averaged 860 Chinook 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 assessment/test, Aboriginal, and sport fisheries) harvested an average of 2,300 large Chinook salmon (fish ≥660 mm). 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 prior to 2005. Canadian inriver assessment/test, Aboriginal, and sport fisheries targeted Chinook salmon and harvests were typically <1,000 large fish. The most recent 5-year (2013-2017) average preliminary harvest from District 108 gillnet fisheries is 1,511 Chinook salmon, while the most recent 5-year Canadian harvest is 2,958 Chinook salmon. The marine recreational fishery targeting Stikine River Chinook salmon remained open in the Wrangell-Petersburg area in 1985–2017 and harvests ranged from 656 to 4,300 fish (Richards et al. 2012; Jaecks et al. *Unpublished*; Courtney et al. *Unpublished*). In 2018 the marine recreational fishery near Petersburg and Wrangell was closed to retention of Chinook salmon from April 1st through June 14th.

In 1981, the Chinook salmon management program was formalized into a 15-year program designed to rebuild spawning escapements by 1995 (ADF&G 1981), and restore production to a level capable of supporting sustainable fisheries in Alaska and Canada. To track rebuilding, ADF&G and DFO 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 for Chinook salmon in the Stikine River are based on a count 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 represented a consistent index of escapement. In 2016, the weir was modified to include passive video monitoring equipment to measure length of fish and count fish passage into the Little Tahltan River system.

A cooperative program between ADF&G, DFO, and the Tahltan First Nation (TFN) was started in 1995 as a pilot study to estimate escapement and inriver harvest of Stikine River Chinook salmon. The pilot study showed that a mark-recapture experiment 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 (SE = 1,978) large fish (Pahlke and Etherton 1998).

The studies revealed that Chinook salmon stocks in the Stikine River had 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. Initial harvests were large, followed by steep declines through 2008. Harvests were relatively stable from 2009 to 2016 but have declined again after 2016 with the lowest harvest on record occurring in 2018 (Table 1). Annexes to the 2008 Pacific Salmon Treaty expired in 2018, and Annex provisions were renegotiated and accepted in December 2018. 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 Stikine River forecast uses a sibling model, with data from previous years used to predict the upcoming run size. The forecast takes into account the percent difference between original model outputs and actual terminal runs for the previous five years. Although Stikine River Chinook are managed based on large (≥660 mm) fish, an age composition for all fish is needed to help with sibling forecasts for later years and if possible, an escapement estimate of all ages. The preseason terminal run forecast for 2019 is 8,250. As a result, no directed commercial fisheries on Chinook salmon will occur in the U.S. or Canadian waters in 2019. Terminal run forecast estimates will similarly be compiled for both 2020 and 2021 using both inriver and marine harvests and data gathered during the mark-recapture experiment.

Escapement estimates for the entire Stikine River were also compared to counts at the Little Tahltan River weir. The 1996 count through the Little Tahltan River weir was 4,821 fish, or about 17% of the estimated Stikine River 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 there has been a downward trend beginning in 2007 (e.g., 2007 (3%), 2010 (7%), 2012 (3%) and 2013 (5%, Table 2). A landslide at the mouth of the Tahltan River in spring 2014 potentially affected escapement and fish behavior (or both), since the number of fish passing the weir represented only 0.7% of the total Stikine escapement in 2014 and 2% in 2015. Telemetry studies were conducted in 2015 with 1% and 2016 with 10% of the tagged fish with fates in the Little Tahltan River. These proportions are comparable to the estimated 2% in 2015 and the 9% in 2016 of the proportion of the escapement that passed the Little Tahltan River weir.

Table 1.–US and Canadian terminal harvest of Stikine River large (≥660 mm MEF) Chinook salmon and years of directed fisheries, 2005-2018.

Year	U.S. Harvest	Canada Harvest	Total Harvest	Directed Commercial Fisheries	Source
2005	27,882	20,016	47,898	Yes	Richards et al. (2008)
2006	22,060	15,776	37,836	Yes	Richards et al. (2012)
2007	10,885	10,505	21,390	Yes	Richards et al. (2012)
2008	7,335	7,906	15,241	Yes	Richards et al. (2012)
2009	1,350	2,284[b]	3,634	No	Jaecks et al. (*Unpublished*)[1]
2010	1,303	1,819[b]	3,122	No	Jaecks et al. (*Unpublished*)[2]
2011[a]	2,145	2,336[b]	4,481	No	Courtney et al. (*Unpublished*)[3]
2012[a]	2,370	4,642[b]	7,012	Yes	Courtney et al. (*Unpublished*)[4]
2013[a]	1,566	1,954[b]	3,520	No	Courtney et al. (*Unpublished*)[5]
2014[a]	1,622	1,974[b]	3,596	No	Courtney et al. (*Unpublished*)[6]
2015[a]	1,438	4,233[b]	5,671	No	Courtney et al. (*Unpublished*)[7]
2016[a]	1,707	3,235	4,942	No	Courtney et al. (*Unpublished*)[8]
2017[a]	207	603	810	No	Courtney et al. (*Unpublished*)[9]
2018[a]	37	165	202	No	Courtney et al. (*Unpublished*)[10]

[a] Preliminary

[b] Includes directed Chinook assessment/test fishery harvests 2009–2015.

[1] Jaecks, T.A., P. Etherton, and P.J. Richards. *Unpublished*. Abundance of the Chinook salmon escapement on the Stikine River, 2009. Alaska Department of Fish and Game, Division of Sport Fish. Draft in Review, located at: Alaska Department of Fish and Game, Juneau

[2] Jaecks, T.A., P. Etherton, and P.J. Richards. *Unpublished.* Abundance of the Chinook salmon escapement on the Stikine River, 2010. Alaska Department of Fish and Game, Division of Sport Fish, Fishery Data Series, Anchorage. Draft in Review, located at: Alaska Department of Fish and Game, Juneau

[3] Courtney, K.R., P. Etherton, and P.J. Richards. *Unpublished*. Abundance of the Chinook salmon escapement on the Stikine River, 2011. Alaska Department of Fish and Game, Division of Sport Fish. Located at: Alaska Department of Fish and Game, Juneau

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[5] Courtney, K.R., P. Etherton, and P.J. Richards. *Unpublished*. Abundance of the Chinook salmon escapement on the Stikine River, 2013. Alaska Department of Fish and Game, Division of Sport Fish. Located at: Alaska Department of Fish and Game, Juneau

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[7] Courtney, K.R., P. Etherton, and P.J. Richards. *Unpublished*. Abundance of the Chinook salmon escapement on the Stikine River, 2015. Alaska Department of Fish and Game, Division of Sport Fish. Located at: Alaska Department of Fish and Game, Juneau

[8] Courtney, K.R., P. Etherton, and P.J. Richards. *Unpublished*. Abundance of the Chinook salmon escapement on the Stikine River, 2016. Alaska Department of Fish and Game, Division of Sport Fish. Located at: Alaska Department of Fish and Game, Juneau

[9] Courtney, K.R., P. Etherton, and P.J. Richards. *Unpublished*. Abundance of the Chinook salmon escapement on the Stikine River, 2017. Alaska Department of Fish and Game, Division of Sport Fish. Located at: Alaska Department of Fish and Game, Juneau

[10] Courtney, K.R., P. Etherton, and P.J. Richards. *Unpublished*. Abundance of the Chinook salmon escapement on the Stikine River, 2018. Alaska Department of Fish and Game, Division of Sport Fish. Located at: Alaska Department of Fish and Game, Juneau

Table 2.–Estimated spawning escapement of large (≥660 mm MEF) Stikine River Chinook salmon versus Little Tahltan River weir counts in Southeast Alaska and British Columbia, 1996–2018.

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	12,803 [a]	2,245 [a]	18 [a]	Jaecks et al. (*Unpublished*)[11]
2010	15,116 [a]	1,057 [a]	7[a]	Jaecks et al. (*Unpublished*)[12]
2011	14,480 [a]	1,754 [a]	12[a]	Courtney et al. (*Unpublished*)[13]
2012	22,327 [a]	720 [a]	3[a]	Courtney et al. (*Unpublished*)[14]
2013	16,737 [a]	878 [a]	5[a]	Courtney et al. (*Unpublished*)[15]
2014	24,360 [a]	169 [a]	0.7 [a,b]	Courtney et al. (*Unpublished*)[16]
2015	21,342[a]	450[a]	2 [a,b]	Courtney et al. (*Unpublished*)[17]
2016	10,554[a]	921[a]	9[a]	Courtney et al. (*Unpublished*)[18]
2017	7,206[a]	492[a]	7[a]	Courtney et al. (*Unpublished*)[19]
2018	8,355[a]	453[a]	5[a]	Courtney et al. (*Unpublished*)[20]

[a] Preliminary

[b] Weir counts were impacted by a landslide at the mouth of the Tahltan River in 2014.

[11] Jaecks, T.A., P. Etherton, and P.J. Richards. *Unpublished*. Abundance of the Chinook salmon escapement on the Stikine River, 2009. Alaska Department of Fish and Game, Division of Sport Fish. Draft in Review, located at: Alaska Department of Fish and Game, Juneau

[12] Jaecks, T.A., P. Etherton, and P.J. Richards. *Unpublished.* Abundance of the Chinook salmon escapement on the Stikine River, 2010. Alaska Department of Fish and Game, Division of Sport Fish, Fishery Data Series, Anchorage. Draft in Review, located at: Alaska Department of Fish and Game, Juneau

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[14] Courtney, K.R., P. Etherton, and P.J. Richards. *Unpublished*. Abundance of the Chinook salmon escapement on the Stikine River, 2012. Alaska Department of Fish and Game, Division of Sport Fish. Located at: Alaska Department of Fish and Game, Juneau

[15] Courtney, K.R., P. Etherton, and P.J. Richards. *Unpublished*. Abundance of the Chinook salmon escapement on the Stikine River, 2013. Alaska Department of Fish and Game, Division of Sport Fish. Located at: Alaska Department of Fish and Game, Juneau

[16] Courtney, K.R., P. Etherton, and P.J. Richards. *Unpublished*. Abundance of the Chinook salmon escapement on the Stikine River, 2014. Alaska Department of Fish and Game, Division of Sport Fish. Located at: Alaska Department of Fish and Game, Juneau

[17] Courtney, K.R., P. Etherton, and P.J. Richards. *Unpublished*. Abundance of the Chinook salmon escapement on the Stikine River, 2015. Alaska Department of Fish and Game, Division of Sport Fish. Located at: Alaska Department of Fish and Game, Juneau

[18] Courtney, K.R., P. Etherton, and P.J. Richards. *Unpublished*. Abundance of the Chinook salmon escapement on the Stikine River, 2016. Alaska Department of Fish and Game, Division of Sport Fish. Located at: Alaska Department of Fish and Game, Juneau

[19] Courtney, K.R., P. Etherton, and P.J. Richards. *Unpublished*. Abundance of the Chinook salmon escapement on the Stikine River, 2017. Alaska Department of Fish and Game, Division of Sport Fish. Located at: Alaska Department of Fish and Game, Juneau

[20] Courtney, K.R., P. Etherton, and P.J. Richards. *Unpublished*. Abundance of the Chinook salmon escapement on the Stikine River, 2018. Alaska Department of Fish and Game, Division of Sport Fish. Located at: Alaska Department of Fish and Game, Juneau

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, 2016, 2017, and 2018 (Table 2), whereas the Little Tahltan escapement objective has not been met since 2006. The weir count and its comparison to the estimated spawning escapement will continue to be monitored.

PRIMARY OBJECTIVES

1. Estimate annually the spawning escapement of large (≥660 mm MEF) Chinook salmon above the U.S.-Canada border annually such that the estimate is within 25% of the true value 95% of the time. This satisfies the PSC CTC requirement of a CV of 15% or less.
2. Estimate annually the age, sex, and length compositions of Chinook salmon captured in inriver commercial and assessment fisheries such that the estimates are within 5 percentage points of the true values 95% of the time.
3. Estimate annually the age, sex, and length compositions of all Chinook salmon spawning above the U.S.-Canada border such that the estimates are within 8 percentage points of the true values 95% of the time.

SECONDARY OBJECTIVES

1. Estimate annually the spawning escapement of Chinook salmon <660 mm MEF.
2. Estimate annually the inriver run at Kakwan Point of large Chinook salmon and Chinook salmon <660 mm MEF.
3. Estimate annually 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 each year 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. Estimate annually the proportion of large Chinook salmon that pass the Little Tahltan weir.
6. Collect axillary appendages from all fish sampled and tagged at Kakwan Point for genetic stock identification.
7. Estimate inseason abundance of large Chinook salmon using the relationship between event 1 CPUE and inriver abundance.

METHODS

STUDY DESIGN

Spawning Abundance (Objective 1)

A mark-recapture experiment will be used to estimate the inriver abundance of large Chinook salmon at the U.S.-Canada border in the Stikine River, annually 2019-2021. Spawning abundance of large Chinook salmon will be estimated by subtracting the large fish harvested upriver of the border from the inriver abundance. 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 multiplying the proportion of medium and small fish to large fish on the spawning grounds with the estimate of large fish escapement. 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 assessment/test, commercial, and Aboriginal fisheries, at the Little Tahltan video weir, and Verrett River (Figures 1 and 2). Johnny Tashoots Creek (the outlet to Tahltan Lake) may be sampled if the resources are available.

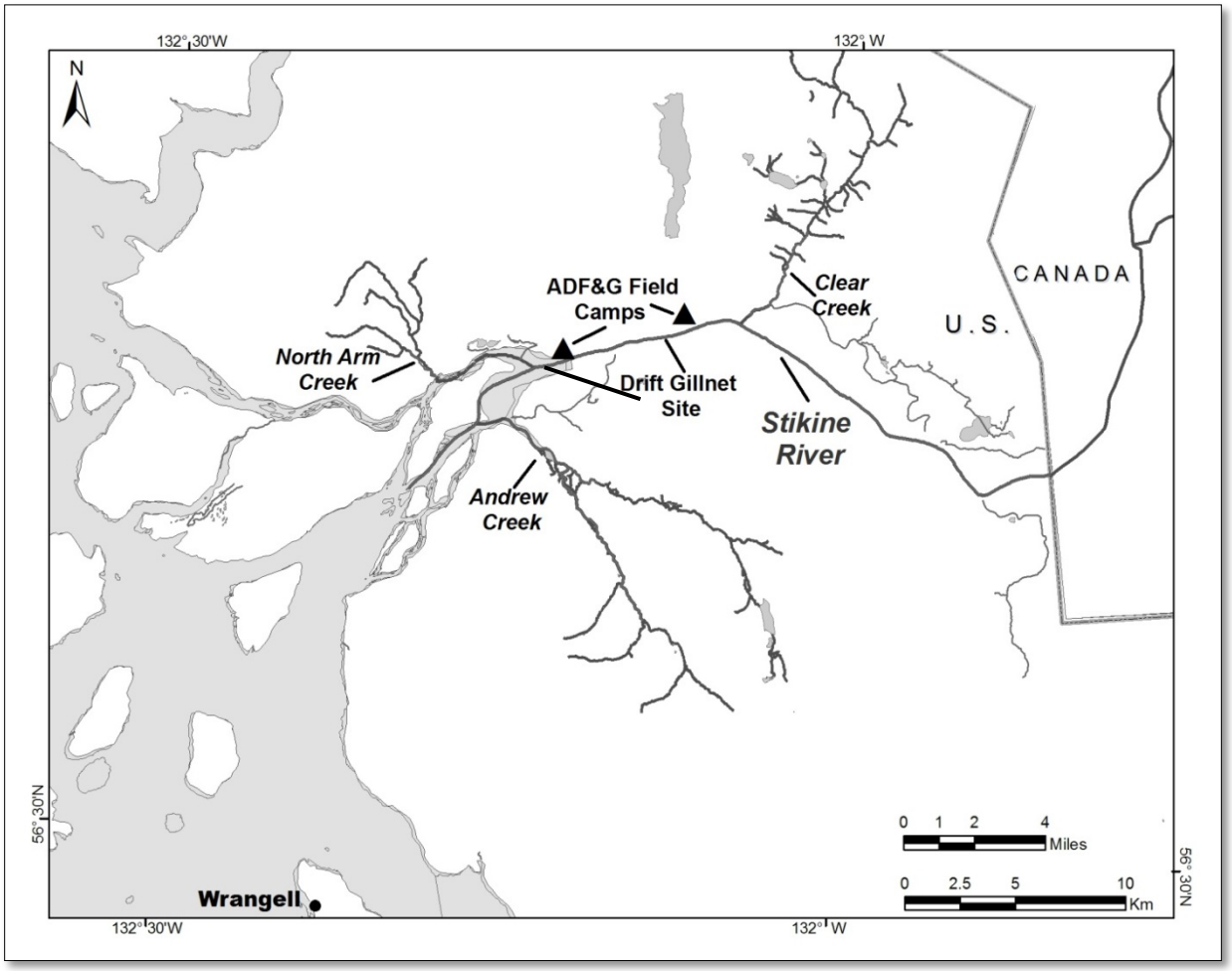

Figure 1.–Drift gillnet sites on lower Stikine River, Southeast Alaska.

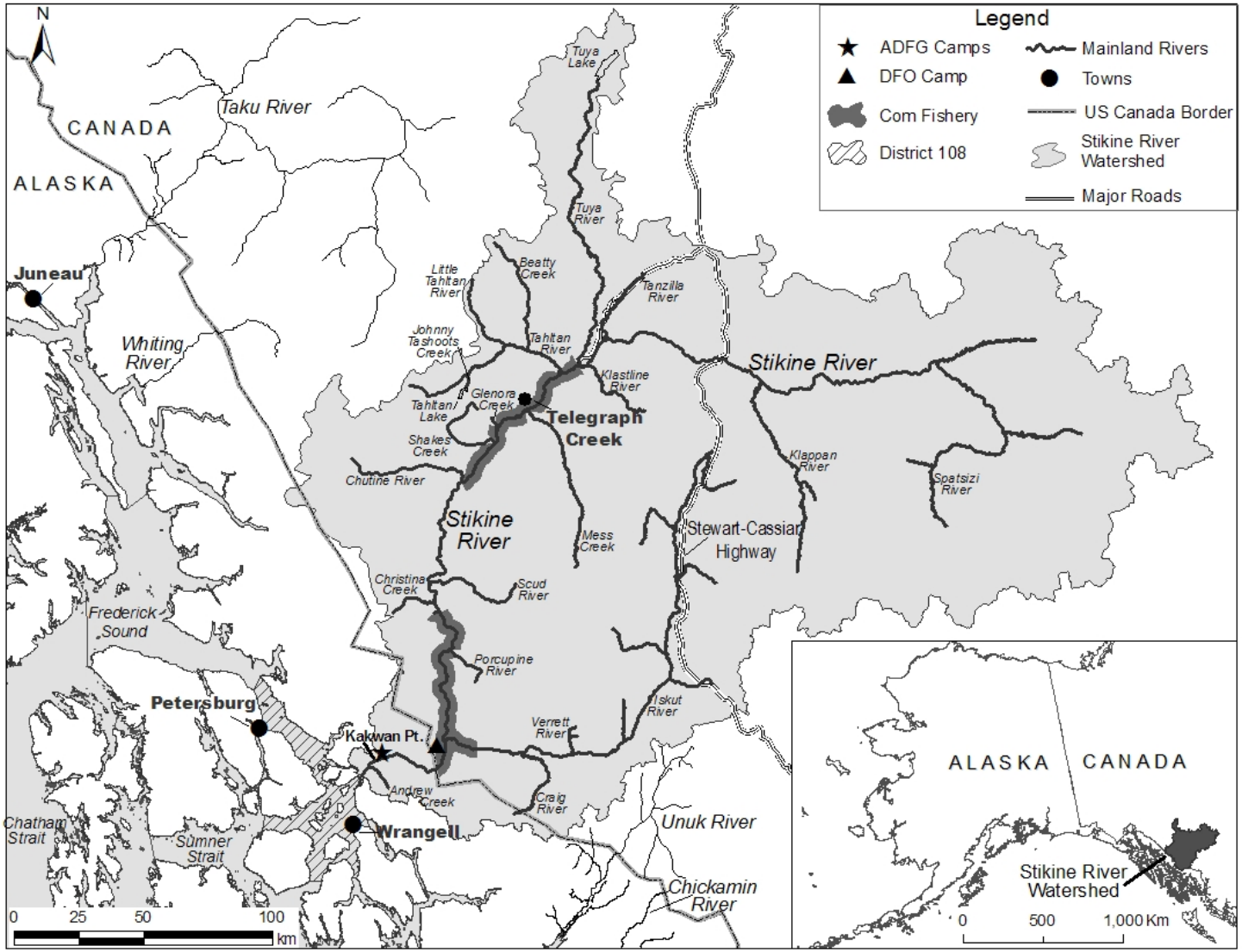

Figure 2.–Stikine River drainage in Southeast Alaska and British Columbia, showing location of principal U.S. and Canadian fishing areas.

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 and identified in 1995 and are refined annually due to changing river conditions. Mesh in drift gillnets will be 18.4 cm (stretch), a size that primarily catches large (fish ≥ 660 mm MEF) and some medium Chinook (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 aiming to fish 7 days per week. For safety, crews will fish at the same time due to high water and frequent debris during the timeframe of this study. It will be a priority to keep fishing effort as constant as possible. The ADF&G and DFO crew leaders will coordinate fishing schedules and ensure 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 ensure a minimum of **4 hours of fishing effort per day per crew is completed**. Drifts at the sites identified on the lower river are short (approximately 15 min), which results in relatively high amount 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.

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 (for both mid eye to caudal fork (MEF) and postorbit of eye-to-hypural (POH)), 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 (ULOP) with a paper punch. 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 help identify marked fish on the spawning grounds up to 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 2019-2021, the axillary appendage of each tagged fish will be collected for genetic stock identification (GSI). All axillary appendages will be stored together in full strength ethanol, labelled with date, location, species, number of sampled, 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 above the international border, and may be assisted by ADF&G personnel. In 2016 the Little Tahltan River Weir was modified to include passive video sampling equipment which allows fish to pass through the weir unimpeded 24 hours per day. Video footage allows determination of the exact number, sex and size of Chinook migrating into the Little Tahltan system. DFO and TFN

personnel will sample a total of about 700 large Chinook salmon to measure length, determine sex, collect scales, and note presence or absence of primary, secondary and/or tertiary marks. Every effort will be made to sample on the spawning 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 spawning grounds increases the chances of not recognizing marks on partially decomposed carcasses. In early August, a second DFO and TFN crew may capture and sample Chinook salmon in the Verrett River if run sizes permit. If time and resources permit, Chinook salmon will be captured and sampled in Johnny Tashoots Creek, the outlet of Tahltan Lake, as well as Beatty and Bear Creeks. 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, but if conditions permit sampling may be attempted.

Additionally, foot surveys will be conducted in August by ADF&G in Andrew Creek as part of the PST regionwide escapement sampling. ADF&G personnel will count spawning salmon to estimate escapement as well as collect age, sex and length samples. The mouth of Andrew Creek is approximately 4km downstream of the tagging site and occasionally tags are recovered during escapement sampling. In the event tagged Chinook salmon are encountered, the number of tags recovered in Andrew Creek will be expanded to the total estimated escapement for Andrew Creek and subtracted from the number of tags (marks) applied at the tagging site. For example, if we sample (inspect) 200 large Chinook salmon in Andrew Creek for age, sex and length, recover 1 tag, and the Andrew Creek escapement is estimated to be 2000, 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 abundance estimates are available.

Inriver Fishery Recoveries

Canadian personnel will take the lead role in sampling any inriver assessment/test fisheries (Chinook and sockeye salmon) and any inriver commercial fisheries, and the Aboriginal gillnet fisheries for tags. Directed inriver Chinook fisheries will not take place in 2019 (based on the adjusted preseason terminal run forecast of 8,250 large fish) and directed fisheries for other species will require the release of all Chinook. Canadian fishermen will remove tags from Chinook prior to release and will submit captured tags to Fisheries and Oceans Canada personnel who 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 often removed by the fisher), and for missing adipose fins. Comparison of tag (mark) rates from the DFO 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).

The approximate number of large salmon to mark in order to obtain desired precision can be determined by approximating two parameters, 1) the inriver run, and 2) the number of fish that are sampled for marks in the second event. These can be approximated using the terminal run forecasts and allowable catches as outlined by the Pacific Salmon Treaty (2018). Terminal run forecasts dictate allowable catch (AC) above a certain base level catch (BLC) for US and Canadian fisheries. The approximate inriver run would be the terminal run forecast reduced by US catches. In recent years only about ½ of the U.S. base level catch (BLC) has been utilized so in order to calculate the inriver run we take the forecast and subtract 1,700 (half of the U.S. BLC) and subtract all of the U.S. allowable catch (AC). The second event in the escapement estimate includes many of the Canadian fisheries. We expect about 64% of the total Canadian catch as outlined in treaty language to become a part of our second event. The 64% rate assumes a recent trend of 85% utilization of base level, allowable and/or test fishery catches and that a 75% inspection rate of those fish will continue to hold true. These two rates are from median values of the last 5 years, 2014- 2018. Additionally, we intend to inspect about 500 fish on the spawning grounds, as at least this many have been inspected in all years (Table 3). With this information, sample sizes to mark can be calculated to ensure that the half width of a 95% CI is within 25% of the estimate as outlined in Robson and Regier (1964). Based on estimates from telemetry studies in 2015 and 2016, 20% of fish that were tagged at Kakwan point did not cross the border into Canada (Courtney et al. *Unpublished*), biasing our mark recapture inriver run estimates high. We can account for this 20% dropout rate by reducing the number of marked fish in the first event by 20%. For example, in 2018 a total of 67 large Chinook salmon were tagged in event 1. However, this number was reduced to 54 (a 20% reduction) when used in the Peterson mark-recapture model (Table 3).

In 2019 the terminal run forecast is 8,250. As the terminal run forecast is below the allowable catch threshold, there will not be any directed harvest for Stikine River Chinook in US or Canadian fisheries in 2019. The average Canadian catch (harvest + release) from the last 5 years is 2,088. We expect 64% of these fish, or about 1,356, to be inspected for tags along with 500 fish from the spawning grounds, for a total of 1,835 large fish in our second event. Per the procedure in Robson and Regier (1964), our tagging target for this scenario is 237 large Chinook salmon at Kakwan Point. This sample size will result in a 95% relative precision (RP) of 25% for an estimate of passage by Kakwan Point and also satisfy the PSC's requirement of escapement estimates have a CV of 15% or less (PSC Joint Chinook Technical Committee 2013, pg 244). Note: in the execution of meeting the tagging goal for large Chinook salmon, all Chinook salmon, regardless of size, will be tagged.

These calculations are germane to years that are most similar to the past 5 years, which may serve this 3-year plan well. We intend to mark and inspect as many fish as possible, but the sample sizes likely will be smaller than what is described in the figure. Each year, we will start sampling immediately in established fishing sites with proven techniques, while also modifying the net depth and location in response to seasonal changes in the river channel and in adjustment to water depth. We will also continue sampling efforts at the Little Tahltan River and attempt to bolster sampling sizes at other escapement areas.

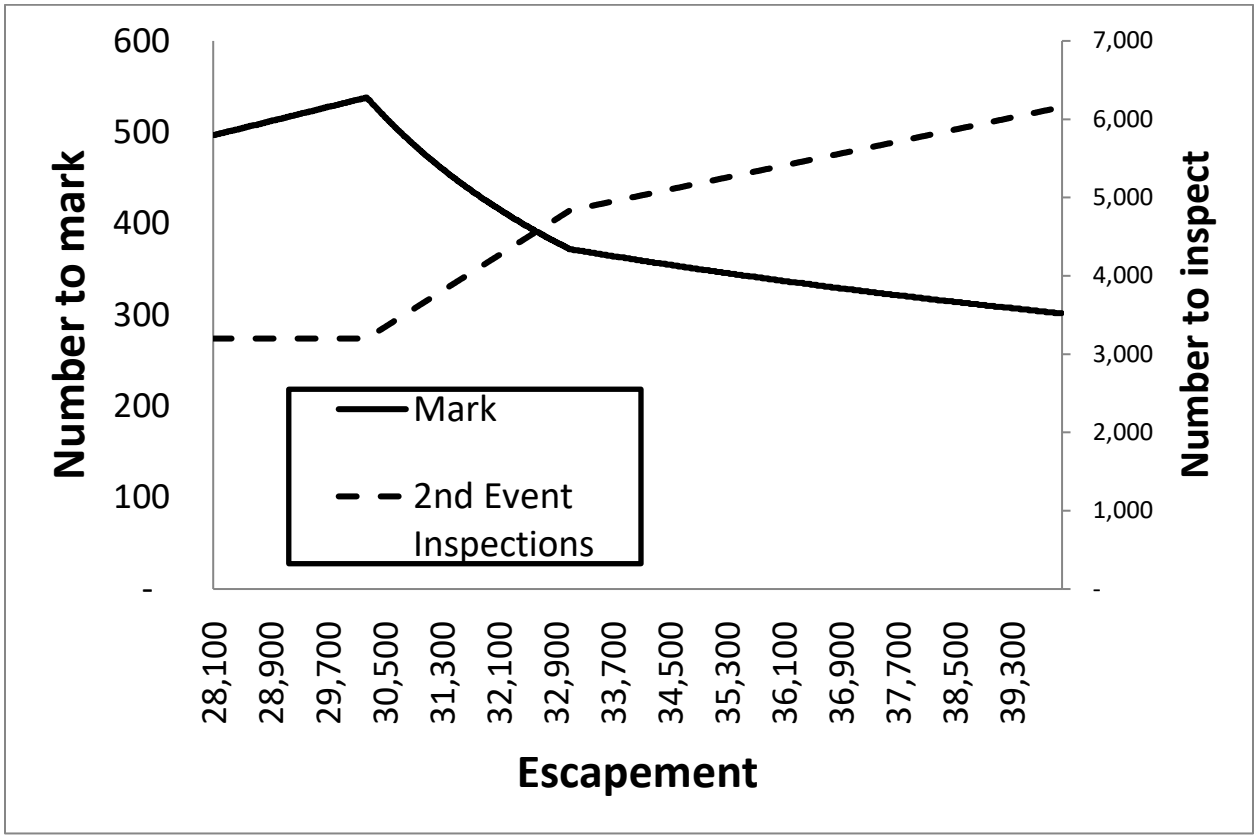

Figure 3.–Number of large (660 mm MEF) Chinook salmon to mark (event 1) and inspect for marks (event 2) to estimate escapement within 25% of the true value 95% of the time.

Table 3.–Number of Chinook salmon ≥660 mm MEF marked and inspected for marks and estimates of inriver run size, Stikine River 1996–2018.

Year	Marked	Inspected	Estimated inriver run size	Inriver run size 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	7.40%
2005	1,228	21,381	59,885	4.20%
2006	519	16,356	40,181	16.79%
2007	343	10,691	25,069	8.80%
2008	420	7,051	26,284	11.43%
2009	138	2,123	15,118	21.73%
2010	402	3,371	18,312	10.31%
2011	507	3,335	17,652	9.01%
2012	380	5,204	27,542	10.46%
2013	253	3,173	20,154	14.25%
2014	277	3,387	27,701	15.76%
2015[a]	234	3,729	19,478	13.20%
2016[a]	141	2,808	11,731	14.60%
2017[b]	65	1,064	6,389	26.20%
2018[b]	54	1,115	8,768	32.93%
Average 1996–2018	554	5,015	30,536	13.23%

[a] 2015 and 2016 number of marked fish reduced to the number of radio telemetry tagged fish that were determined to have crossed the US/Canadian border.

[b] 2017 and 2018 number of marked fish reduced by 20% to account for dropout rate determined by telemetry work in 2015 and 2016.

Age, Sex, Length Composition of Chinook Salmon Harvest (Objective 2)

Age, sex, and length composition data for Chinook salmon harvested upriver of the border will be estimated. Chinook salmon will be sampled at the Canadian processing facilities on the Stikine River. In years when fisheries occur, we will sample every second large fish. Sampled fish will be inspected for adipose fin clip-CWTs, scales, sex and length. Ages will be determined from patterns of circuli according to objective criteria developed by the DCF scale-aging group (Olsen 1992).

Sample Size

Based on the 2019 forecast, there will be no directed harvest due to low abundance. In 2020 and 2021, fisheries may occur. The sample sizes needed to estimate the age, sex, and length composition were determined using the methods outlined in Thompson (2002). The sample size required to meet the objective criteria for estimating age composition is 636, which assumes scale readability is 80% (509/80%). The sample size needed to meet the objective criteria for estimating sex composition is 384. The sample size needed to meet the objective criteria for estimating length composition is 509. Sample size calculations assume that harvest is large relative to the sample size. If this is not true, then these sample sizes will tend to be overly-conservative. Sample size calculations also assume that fish are equally distributed across age-, sex-, and length-classes and are therefore conservative. Collecting the required number of samples should be easily met in years with commercial fisheries and we expect to meet the objective criteria.

Age, Sex, Length Composition of Chinook Salmon Escapement (Objective 3)

Age, sex, and length composition data will be collected from Chinook salmon captured at Kakwan Point, the Little Tahltan River weir, and the Verrett River. Ages will be determined from patterns of circuli according to objective criteria developed by the DCF scale-aging group (Olsen 1992). All fish captured at Kakwan Point will be sampled. In years where sampling occurs, all fish handled at the Verrett River will be sampled for age, sex and length. At the Little Tahltan River weir, video data will be used to collect length and sex information for all fish and in years when fish are handled, age data will also be collected. Data collected at the Little Tahltan River weir and the Verrett River should be more representative of overall spawning escapement age composition because these systems are upstream of Kakwan Point and the inriver fisheries, both of which may be size-, sex-, or age-selective. Data from separate sampling locations may be pooled when estimates are not statistically different. If age compositions among sources vary, then the Little Tahltan weir and Verrett River data will be used. Scales from a systematically drawn sample Chinook salmon must be collected from the escapement to meet objective criteria.

In recent years, there has been an increase in the proportion of small and medium fish passing through the Little Tahltan River weir. The reason for this elevated presence of smaller fish is unknown but may be a combination of weir effects and the landslide that occurred in 2014 that significantly increased the velocity near the mouth of the Tahltan River. The weir method changed beginning in 2016, and now includes video equipment to monitor fish passage through the weir. Calibration information for fish length is currently being assessed but monitoring with video equipment allows for a more accurate assessment of the number and sex of Chinook salmon passing upstream into the Little Tahltan River.

Sample Size

The sample size needed to estimate the age-, sex-, and length-compositions were determined using the methods outlined in Thompson (2002). The sample size required to meet the objective criteria for estimating age composition is 249, which assumes scale readability is 80% (199/80%). The sample size needed to meet the objective criteria for estimating sex composition is 150. The sample size needed to meet the objective criteria for estimating length composition is 199. Sample size calculations assume that escapement is large relative to the sample size. If this is not true, then these sample sizes will tend to be overly-conservative. Sample size calculations also assume that fish are equally distributed across age-, sex-, and length-classes and are therefore conservative.

Collecting the required number of samples for age, sex and length composition will be difficult in 2019-2021. In 2018, no scale samples were collected at the Little Tahltan River weir or on the Verrett River due to the extremely low abundance of adult Chinook salmon and only 54 fish were captured and sampled at Kakwan Point (Table 3). The Little Tahltan River weir will be able to collect sex and length information for fish using the video data, however until abundance increases, scales will not be collected. The 2019 forecasted abundance is similar to observed 2018 abundance and therefore we don't anticipate being able to collect the required number of samples in 2019. These low abundances may persist into 2020-2021, which would again cause us not to be able to collect the required number of samples. In order to ameliorate the effect of low abundances, from 2019-2021 we will: 1) maintain or increase the current level of effort and 2) maintain an electric fence at the Little Tahltan River weir to deter bears. If recent trends in abundance change, we anticipate that we will be able to meet the objective criteria using current methods.

DATA COLLECTION

Capture and Tagging

Effort and catch during drift gillnetting operations will be recorded on forms drafted by ADF&G and DFO. Weekly scheduling and effort will be determined by onsite staff in consultation with the project leaders (Courtney and Foos). 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°C (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) as detailed in the next section.

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 DFO on forms provided by their tag lab (Secondary Objective 4). In addition to potential CWT-tagged Chinook salmon strays, in 2019, we anticipate the return of age-1.1 to age-1.5 Stikine River Chinook salmon from the 2012–2016 brood years that were CWT tagged as smolt in spring 2011–2015. 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®[21] label, which will be included with each head shipped. Each head will be shipped to ADF&G in Douglas or DFO 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 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.

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 that 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 operculum 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

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

left operculum 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 operculum 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 operculum 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 DFO 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 DFO 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, Canadian commercial/assessment fishery license conditions stipulate that all tags must be 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 assessment/test fishery and a minimum of 50% of the lower river inriver harvest will also be examined for missing adipose fins. Heads from all Chinook salmon without an adipose fin will be 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 DFO in Whitehorse.

Inseason Estimates of Passage

In order to honor Annex V, Chapter 1, 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. The preseason Chinook salmon forecast is used during statistical 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 1996–2018. Historically, there has been a significant positive relationship between weekly cumulative CPUE and run size for most weeks (DerHovanisian and Etherton 2006). With current low abundance, run size information from weekly CPUE data is unavailable, but cumulative CPUE and total inriver run size estimates are significantly related (R^2 = 0.82). 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 2005–2014 inriver commercial fisheries and the 2000–2003 inriver assessment/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 assessment/test fishery, delayed 2 weeks.

Prior to having inseason estimates of run strength, accurate forecasts are necessary in order to plan for conservation measures during years of low abundance and to prosecute directed Chinook salmon fisheries during years of high abundance. 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 (Bernard and Jones 2014). 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). The performance of both the preseason forecasts of terminal run and inseason estimates from 2005 through 2018 are shown in Table 4.

Injured or Dead Marine Mammals

Consistent with the terms and conditions of the Biological Opinion for Southeast Alaska, if during the course of a marine vessel survey injured or entangled marine mammals are observed, the following protocols will be implemented:

a) Document with photos/video (remain at least 100 yards from the animal) and record the date, time, and location (latitude/longitude, description of bay, point, island, etc.).
b) As soon as possible, report to Alaska Marine Mammal Stranding Network 24-hour Hotline: 877-925-7773 (877-9-AKR-PRD).
c) If a large whale is alive and entangled, immediately call the U.S. Coast Guard at VHF Channel 16.

d) If possible, record the species, age class, sex (for sea lions), type of gear, a description of the gear and how the animal is entangled, its relative degree of impairment, and direction of travel. Include this information in the report to the Hotline/USCG above.
e) For dead animals, if communications allow, contact the Stranding Hotline while you are near the carcass to determine if samples or additional information can be collected.

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 the Douglas ADF&G office, 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 (Foos) 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 DFO will be entered into

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, 2005–2018.

Year	Statistical week	Date	Final estimate[a]	Preseason forecast[b]		Inseason	
				Point	Prediction error	Estimate	Prediction error
2018	21	21 May–27 May	8,768	6,900	-27%	preseason	NA
	22	28 May–03 June	8,768	6,900	-27%	<14,000	NA
	23	04 June- 10 June	8,768	6,900	-27%	<14,000	NA
	24	11 June–17 June	8,768	6,900	-27%	<10,000	NA
	25	18 June–24 June	8,768	6,900	-27%	<10,000	NA
	26	26 June–1 July	8,768	6,900	-27%	<10,000	NA
	27	02 July – 08 July	8,768	6,900	-27%	<10,000	NA
	28	9 July–15 July	8,768	6,900	-27%	<10,000	NA
	29	16 July–22 July	8,768	6,900	-27%	<10,000	NA
2017	21	17 May–23 May	7,938	18,300	57%	preseason	NA
	22	24 May–30 May	7,938	18,300	57%	<14,000	NA
	23	31 may–06 June	7,938	18,300	57%	<14,000	NA
	24	07 June–13 June	7,938	18,300	57%	<10,000	NA
	25	14 June–20 June	7,938	18,300	57%	<10,000	NA
	26	21 June–27 June	7,938	18,300	57%	<10,000	NA
	27	28 June – 04 July	7,938	18,300	57%	<10,000	NA
	28	05 July–11 July	7,938	18,300	57%	<10,000	NA
	29	12 July–18 July	7,938	18,300	57%	<10,000	NA
2016	21	19 May–25 May	13,789	33,912	59%	preseason	NA
	22	26 May–31 May	13,789	33,912	59%	20147	46%
	23	31 may–06 June	13,789	33,912	59%	21846	58%
	24	07 June–13 June	13,789	33,912	59%	21802	58%
	25	14 June–20 June	13,789	33,912	59%	22799	65%
	26	21 June–27 June	13,789	33,912	59%	21159	53%
	27	28 June –04 July	13,789	33,912	59%	19187	39%
	28	05 July–11 July	13,789	33,912	59%	19882	44%
	29	12 July–18 July	13,789	33,912	59%	18089	31%
2015	21	17 May–23 May	27,308	40,600	33%	preseason	NA
	22	24 May–30 May	27,308	40,600	33%	preseason	NA
	23	31 May–06 June	27,308	40,600	33%	preseason	NA
	24	07 June–13 June	27,308	40,600	33%	preseason	NA
	25	14 June–20 June	27,308	40,600	33%	preseason	NA
	26	21 June–27 June	27,308	40,600	33%	28,131	3%
	27	28 June – 04 July	27,308	40,600	33%	29,508	8%
	28	05 July–011 July	27,308	40,600	33%	29,441	8%
	29	12 July–18 July	27,308	40,600	33%	29,441	8%

Table 4.–Page 2 of 4.

Year	Statistical week	Date	Final estimate[a]	Preseason forecast[b]		Inseason	
				Point	Prediction error	Estimate	Prediction error
2014	21	18 May–24 May	29,225	37,700	29%	preseason	NA
	22	25 May- 31 May	29,225	37,700	29%	preseason	NA
	23	01 June- 07 June	29,225	37,700	29%	preseason	NA
	24	08 June-14 June	29,225	37,700	29%	25,031	-14%
	25	15 June- 21 June	29,225	37,700	29%	26,000	-11%
	26	22 June-28 June	29,225	37,700	29%	26,000	-11%
	27	29 June-05 July	29,225	37,700	29%	26,150	-11%
	28	06 July-12 July	29,225	37,700	29%	26,150	-11%
	29	13 July- 19 July	29,225	37,700	29%	26,150	-11%
2013	21	19 May–25 May	21,708	32,032	48%	preseason	NA
	22	26 May–01 June	21,708	32,032	48%	23,800	10%
	23	02 June–08 June	21,708	32,032	48%	20,343	6%
	24	19 June–15 June	21,708	32,032	48%	24,635	13%
	25	16 June–22 June	21,708	32,032	48%	22,944	6%
	26	23 June–29 June	21,708	32,032	48%	24,861	15%
	27	30 June–06 July	21,708	32,032	48%	22,921	6%
	28	07 July–13 July	21,708	32,032	48%	21,930	1%
	29	14 July–20 July	21,708	32,032	48%	21,930	1%
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	03 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	01 July–06 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–04 June	20,557	30,000	46%	18,327	-11%
	24	05 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–02 July	20,557	30,000	46%	21,206	3%
	28	03 July–09 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–05 June	23,356	22,900	-2%	22,300	-3%
	24	06 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	04 July–10 July	23,356	22,900	-2%	21,924	-6%
	29	11 July–17 July	23,356	22,900	-2%	21,924	-6%

Table 4.–Page 3 of 4.

Year	Statistical week	Date	Final estimate[a]	Preseason forecast[b]		Inseason	
				Point	Prediction error	Estimate	Prediction error
2009	21	17 May–23 May	15,006	32,000	213%	preseason	NA
	22	24 May–30 May	15,006	32,000	213%	preseason	NA
	23	31 May–06 June	15,006	32,000	213%	25,500	68%
	24	07 June–13 June	15,006	32,000	213%	25,200	65%
	25	14 June–20 June	15,006	32,000	213%	24,700	65%
	26	21 June–27 June	15,006	32,000	213%	24,700	57%
	27	28 June–04 July	15,006	32,000	213%	23,600	33%
	28	05 July–11 July	15,006	32,000	213%	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	01 June–07 June	36,414	46,118	27%	44,000	21%
	24	08 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 July–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–05 June	66,952	60,600	-9%	65,800	-2%
	24	06 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	01 June–07 June	89,626	94,392	5%	72,388	-19%
	24	08 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

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[a] Final estimates from 2005 to 2014 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.

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 DFO will exchange spreadsheet files. Copies of the data and a data map will be sent to the 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, Harvest, and Inriver Run of Chinook Salmon ≥660 mm

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

$$\hat{N}_{LE} = \hat{N}_{LR} - \hat{N}_{LH} \tag{1}$$

where:

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

$$\hat{N}_{LR} = \frac{(\hat{M}+1)(C+1)}{(R+1)} - 1$$

$\hat{M}$ = Estimated number of large (Kakwan Point) marked Chinook present for possible recovery in the inriver fisheries or on the spawning grounds, which will be the number of marked fish minus the estimated fish that moved downstream; $\widehat{M} = M - \widehat{M}_d$

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 on 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; or

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

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

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

3. there is no tag-induced mortality or behavior; 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. The reasons are as follows. Stocks within the Stikine River have different inriver migratory patterns (Pahlke and Etherton 1999), so complete mixing of marked and unmarked fish is not possible (1c). Inspection efforts will be restricted to the inriver Chinook assessment/test and sockeye gillnet fisheries, Little Tahltan River, Verrett River, and perhaps other large spawning concentrations. Fish at the targeted spawning grounds will have a higher probability of being captured, and while the fishery targets may capture a mix of stocks, fishing effort will not necessarily be constant, and probability of capture for stocks with different timing and migratory patterns 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 (1b). Because these two conditions will not be satisfied, our chance for an unbiased estimate of spawning abundance of large fish depends solely 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. We will use the contingency table tests outlined in Appendix B2 to determine whether a simple Chapman modified Lincoln-Petersen estimator (described above) or a partially stratified estimator (e.g. Darroch 1961, Schwarz and Taylor 1998) should be used. Such tests have 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.

Multiple 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, age, sex and length will be 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). To help account for downstream movement the estimated number of marked fish that reach the inriver fisheries and upriver spawning grounds ($\hat{M}$) will be the number of marked fish minus estimated marked fish that have moved downstream. Marked fish have been caught downstream 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 operated from 1976–1984 and 1997. 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 2013 as a result of recoveries in the U.S. gillnet and sport fisheries and in Andrew and North Arm creeks was 22 (1 from the District 108 commercial gillnet fishery and 3, expanded to 21, from Andrew Creek), however similar sampling in 2014 encountered no tagged fish. 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 2013 mark-recapture study was about 8.7% (22 out of 253 applied). Telemetry studies were conducted again in 2015 and 2016 and were used to track downstream movement of fish as well as the number of fish that did not cross the border. Fish that did not cross the border were censored from the mark-recapture study. In 2015, 66 of 299 tags (22%) were censored from the study and in 2016, 31 of 169 (18%) were censored from the study. The average of these two years (20%) was applied to the 2018 number of marks to censor fish from the experiment. 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.

Table 5.–Capture histories for Chinook salmon in the Stikine River mark-recapture experiment, 2019-2021.

1. Marked but censored in U.S. marine recreational fishery.
2. Marked but censored in U.S. marine commercial fisheries.
3. Marked but censored 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.

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:

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

where $\bar{\hat{N}}^*_{LR}$ 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 2010–2014) and a typical relative 95% precision is less than 2% so the parameter $\hat{N}_{LH}$ is treated as a constant and:

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

Spawning Escapement, Harvest, 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 for spawning escapement of fish <660 mm will be calculated using Equations 1 through 3. 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% for a 95% CI) or has less than 7 recaptures (Seber 1982), then the spawning escapement estimate <660 mm fish will be estimated by multiplying the spawning escapement of large fish by the proportion of large fish on the spawning ground minus 1:

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

where $\hat{p}_{LE}$ is the estimated fraction of large fish in the spawning population, obtained from spawning ground ASL sampling.

The variance of the estimate of the escapement of fish <660 mm will be estimated (Goodman 1960):

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

where, by the delta method,

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

where n_E is the number of fish sampled for length on the spawning grounds. 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 $\hat{N}_{<660\,E}$ 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:

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

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

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

Spawning Escapement and Inriver Run of All Chinook Salmon

Total inriver run at Kakwan Point will be estimated as:

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

with estimated variance as either:

$$\text{var}(\widehat{N}_R) = \text{var}(\widehat{N}_{<660R}) + \text{var}(\widehat{N}_{LR}) \tag{10a}$$

or

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

where both $\text{var}(\widehat{N}_{<660R})$ and $\text{var}(\widehat{N}_L)$ in Equation 10a are computed using Equation 3. Equation 10a will be used when a sufficient number of <660 mm MEF fish are marked, inspected and recaptured and Equation 10b will be used otherwise.

Total spawning escapement will be estimated as:

$$\hat{N}_E = \hat{N}_{<660E} + \hat{N}_{LE} \tag{11}$$

with estimated variance (harvest is known):

$$\text{var}(\widehat{N}_E) = \text{var}(\widehat{N}_R) \tag{12}$$

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 will be estimated by:

$$\hat{\pi} = \frac{\hat{N}_{LE}}{W_L} \tag{13}$$

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

Large fish can be visually distinguished from smaller fish as they pass through the weir with negligible error, which makes 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/sex *j* will be estimated as a binomial variable from fish sampled from the fishery:

$$\hat{p}_{ijH} = \frac{n_{ijH}}{n_{iH}} \tag{15}$$

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

where n_{ijH} is the number of Chinook salmon of age/sex *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:

$$\hat{N}_{jH} = \sum_i \hat{p}_{ijH} \hat{N}_{iH} \tag{17}$$

with variance estimated as:

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

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 (Thompson 2002).

Age, Sex, and Length Composition of Spawning Escapement

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

$$\hat{p}_{ij\,E} = \frac{n_{ij\,E}}{n_{i\,E}} \tag{19}$$

$$\text{var}[\hat{p}_{ij\,E}] = \frac{\hat{p}_{ij\,E}(1 - \hat{p}_{ij\,E})}{n_{i\,E} - 1} \tag{20}$$

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

Numbers of spawning fish of age/sex *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 $\hat{N}_{<660E}$ 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 <660 mm 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:

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

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

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

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

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

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

Equations 19 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):

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

If insufficient tags are recovered from fish <660 mm 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 (Thompson 2002).

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:

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

SCHEDULE AND DELIVERABLES

Field activities for tagging Chinook salmon at Kakwan Point will begin late April and extend through mid-July. Field activities for enumeration, sampling, and recovery of tagged Chinook at the Little Tahltan River will begin in late June through to mid-August. Recovery efforts on Verrett River and other spawning grounds may 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 any Stikine River assessment/test, commercial and Aboriginal fisheries. 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 each year. Data from the recovery locations will be sent to Kristin Courtney in Juneau by 31 October each year, and then entered into Excel™ spreadsheets, edited, and distributed for any final editing by 30 January each year to DFO. A draft FDS report summarizing each years escapement estimate and age, sex, and length composition will be prepared by April 30 the following year. The draft will be distributed to DFO for review and returned to ADF&G by July 1. A final report will be submitted for peer review by September 1. Other reporting requirements exist for this project and are funding entity specific; schedules and deliverables for these requirements will be adhered to as identified in annual grant proposal packages and may include semi-annual, annual, and final reports as well as an obligation to present results during annual meetings.

RESPONSIBILITIES

I. Agency Responsibilities

A. ADF&G. Will plan project in cooperation with DFO. Will write operational plan with DFO. 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 DFO. 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 DFO.

B. DFO. 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 with sampling the inriver commercial fishery. Will cover the costs and logistics associated with tag recoveries. Will provide tagging, recovery, and age data to ADF&G (Sport DSF) by 31 October each year. Will review data, provide input into report, write sections regarding recovery and serve as co-author.

II. U.S. Personnel Responsibilities

Kristin Courtney, FBII, Project Leader. In concert with Philip Richards, and Jody Mackenzia-Grieve, 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.

Randy Peterson, Biometrician II. Provides input to and approves sampling design. Reviews operational plan and provides biometric details. Writes code for and completes data analysis and reviews final report.

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.

Stephen Todd, FBI. This position is responsible for supervising one portion of the field tagging program. Will coordinate schedules with DFO-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.

Brendan Jackson, FTIII. Will be crew lead and 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.

Chris Kamal, 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

Jody Mackenzie-Grieve, Senior Aquatic Science Biologist. In concert with Kristin Courtney, Philip Richards, and Johnny Sembsmoen, will oversee and assist with all Canadian aspects of the project including planning, budget, sample design, permits, equipment, and supervising field operations. Coalesces, edits, analyzes and reports data; assists with fieldwork

Johnny Sembsmoen, Senior Aquatic Science Technician. In concert with Kristin Courtney, Philip Richards, Stephen Todd, and Jody Mackenzie-Grieve will coordinate and 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 as needed 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.

Cheri Frocklege. Fisheries Program Manager, Tahltan First Nation. Will coordinate and oversee all TFN involvement in the program. May participate in field components as required.

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.

Drew Inkster, 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.

Various DFO and TFN Technicians. Will conduct all aspects of field operations, including safe operation of equipment, sampling, tag recovery data collection, and general field camp duties. Will assist in equipment and camp maintenance.

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APPENDIX A: PROJECT DATA FORMS

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							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
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										
					6										
					7										
					8										
					9										
					10										
					1										
					2										
					3										
					4										
					5										
					6										
					7										
					8										
					9										
					10										
					1										
					2										
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					4										
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					6										
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					8										
					9										
					10										
					1										
					2										
					3										
					4										
					5										
					6										
					7										
					8										
					9										
					10										

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: 2015 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		Tag Count	Tags Out	
			Beginning Number	Ending Number		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					

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.

Discard remaining ethanol from the 500 ml bottle before returning samples. **Tissue samples must remain in 2 ml 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:

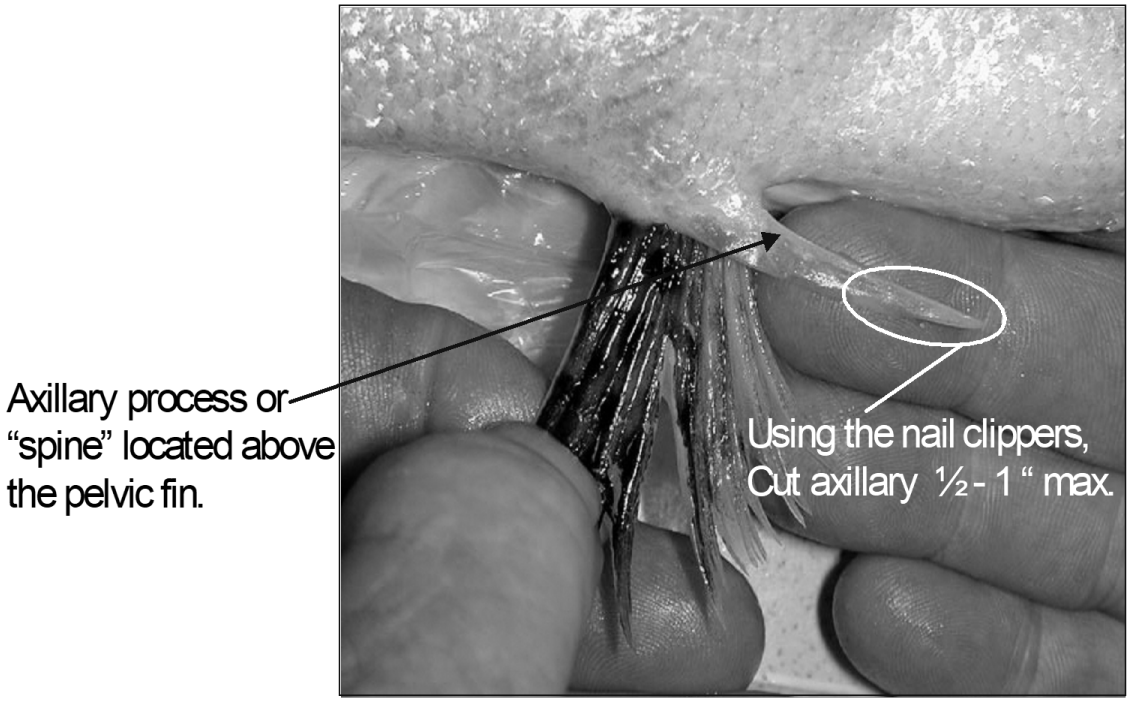
1. (1) - Dog toe nail clipper - used for cutting the axillary process
2. (1) - Scissors can be used to cut a portion axillary process – if clippers don't work for your crew
3. Cryovial- a small (2 ml) plastic vial, pre-labeled.
4. Caps - with or without gasket to prevent evaporation of ETOH.
5. Cryovial rack- white plastic rack with holes for holding cryovials while sampling
6. Ethanol (ETOH) - in (2) 500 ml plus (1) - 125 ml Nalgen 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.

Ship samples to: ADF&G - Genetics
333 Raspberry Road

Lab staff: 1-907-267-2247
Nick Decovich: 1-907-267-2239

Axillary process tissue for Genetic Stock Identification (GSI)



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										
				1										
				2										
				3										
				4										
				5										
				6										
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				9										
				10										
				1										
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				2										
				3										
				4										
				5										
				6										
				7										
				8										
				9										
				10										

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: PROJECT BIOMETRIC DETAILS

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;

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

II.–Equal Proportions Test (SPAS terminology)[b]

	Area/time where examined			
	1	2	…	t
Marked (m_2)				
Unmarked (n_2-m_2)				

III.–Complete Mixing Test (SPAS terminology) [c]

	Area/time where marked			
	1	2	…	s
Recaptured (m_2)				
Not recaptured (n_1-m_2)				

[a] This tests the hypothesis that movement probabilities (θ) from time or area *i* (*i* = 1, 2, s) to section *j* (*j* = 1, 2, t) are the same among sections: H_0: $\theta_{ij} = \theta_j$.

[b] This tests the hypothesis of homogeneity on the columns of the 2-by-t contingency table with respect to the marked to unmarked ratio among time or area designations: H_0: $\Sigma_i a_i \theta_{ij} = k U_j$, where k = total marks released/total unmarked in the population, U_j = total unmarked fish in stratum j at the time of sampling, and a_i = number of marked fish released in stratum i. Note that failure to reject H_0 means the Pooled Petersen estimator can be considered consistent only if the degree of closure among tagging strata is constant ($\Sigma_j \theta_{ij} = \lambda$,) (Schwarz and Taylor 1998). One way this may be achieved is to sample all or the large majority of spawning areas.

[c] This tests the hypothesis of homogeneity on the columns of this 2-by-s contingency table with respect to recapture probabilities among time or area designations: H_0: $\Sigma_j \theta_{ij} p_j = d$, where p_j is the probability of capturing a fish in section j during the second event, and d is a constant.

Appendix B2.–Tests of consistency for the Petersen estimator (from Seber 1982, page 438).

Tests of consistency for Petersen estimator

Of the following conditions, at least one must be fulfilled to meet assumptions of a Petersen estimator:

1. Marked fish mix completely with unmarked fish between events;
2. Every fish has an equal probability of being captured and marked during event 1; or,
3. Every fish has an equal probability of being captured and examined during event 2.

To evaluate these three assumptions, the chi-square statistic will be used to examine the following contingency tables as recommended by Seber (1982). At least one null hypothesis needs to be accepted for assumptions of the Petersen model (Bailey 1951, 1952; Chapman 1951) to be valid. If all three tests are rejected, a temporally or geographically stratified estimator (Darroch 1961) should be used to estimate abundance.

I. –Mixing Test[a]

Area/time	Time/area where recaptured				Not recaptured
where marked	1	2	…	t	(n_1-m_2)
1					
2					
…					
s					

APPENDIX C: STIKINE RIVER COVID ACTION PLAN

ADF&G Covid-19 Response-Stikine Field Action Plan

This Plan assumes that all crew members are negative when they depart for camp and assumes that if a crew member begins to show symptoms once out in field camp, that the other members of the crew have a high level of exposure and are likely infected. There are up to 11 crew members working on this project, five of which reside in Wrangell, five are from elsewhere in Alaska, and one is from out of state. All state and local travel and Covid-19 guidelines will be followed by staff.

Project Title

Stikine River Stock Assessment

Season Start and End Dates

- April 1 to August 15

Administration

Crew members returning from SLWOP will be provided locations where they can complete paperwork while maintaining 6-foot distancing. Every effort should be made to minimize the number of technicians in the workspace at any one time.

One Crew member returning from SLWOP will start April 1st, one crew member will start April 6th, 3 crew members will start April 13th; one crew member will start on April 21st and 3 crew members will start on May 1st.

Nobody will be expected or pressured to participate on these projects. If staff are uncomfortable and would like to withdraw from a project, please let the project leader know as soon as you can so that new plans can be made. These actions will have no bearing on the status the employee's PCN, and their position will be secured until next year.

Project leaders will contact community leaders and/or visit the local community website to determine any community health mandates/requirements prior to entry into the local community or start of a project to communicate the department's intent and how to best address concerns.

Training

Fish capture, handling and tagging trainings for new staff that must be conducted will be done groups of 3 or less while maintaining 6-foot distancing. Standard group trainings such as Firearms, Wildlife Safety, Spot Sexual Harassment and First Aid/CPR will be postponed for this field season, unless individualized online versions are available (e.g., Spot training). Employees that passed the Firearms training since 2019 must be the crew member handling firearms. If possible, staff are encouraged to practice shooting at least once during the early portion of the field season.

Prior to Departure

All staff will be screened for fever prior to returning to work and departure for field camp and no staff who are symptomatic will be allowed to return to work or into the field. Fever screening should be conducted by the Project Leader, Crew Leader or other local available department personnel in the absence of the Project Leader and Crew Leader.

Testing of all staff prior to departure, if feasible/available. For any crew members traveling into Canada for work related activities, as part of the Canada Border Services Agency (CBSA) clearance protocols, a negative polymerase chain reaction (PCR) covid test must be taken within 72 hours of entry and provided to CBSA along with other necessary travel documents.

The DOA has indicated that the SOA is not requiring employees to receive the COVID-19 vaccine. CDC Guidelines for staff who have been fully vaccinated can be found at When You've Been Fully Vaccinated | CDC; Appendix A. A standard set of COVID-19 questions will be asked prior to departure to the field to assess risk and the following guidelines will be followed general or high risk to the community or field crew.

COVID-19 Risk Questionnaire/Questions

- Within the last 14 days have you traveled outside of the state of Alaska or your home community? If YES, see quarantine guidelines.
- Do you have any Covid-related symptoms (wet or dry cough, shortness of breath or difficulty breathing, fever, chills, muscle aches, headache, loss of smell or taste, sore throat, fatigue, etc.)? If YES, see quarantine guidelines.
- Have you been in contact or have been exposed to anyone who has tested positive for COVID-19? If YES, see quarantine guidelines as well as Health Advisory No. 1 Recommendations for Keeping Alaskans Safe. If NO, see SOA guidelines Health Advisory No. 1 regarding practicing good hygiene, social distancing, wearing a mask, monitoring your health, and testing.
- Do you live or take care of someone who have tested positive for COVID-19? If YES, see quarantine guidelines as well as Health Advisory No. 1 Recommendations for Keeping Alaskans Safe.
- Have you been in "close contact" with a person who has tested positive for COVID-19 for more than 10 minutes? Close contact is someone who was within 6 feet of an infectious person for a *cumulative total* of 15 minutes or more over 24 hours while the person was infectious. This definition applies regardless of whether the infected person or close contacts were wearing masks. If YES, see quarantine guidelines as well as Health Advisory No. 1 Recommendations for Keeping Alaskans Safe.
- Were you in the same indoor environment as a confirmed case for a prolonged period but not within 6 feet of the confirmed case? If YES, see Health Advisory No. 1 Recommendations for Keeping Alaskans Safe regarding practicing good hygiene, social distancing, wearing a mask, monitoring your health, and testing.
- Have you had a negative Covid test within the last 72 hours, if not, could you get tested prior to departing for the field and provide the results to your supervisor?

Information and guidelines on when and how to quarantine is available on the CDC and DHSS webpages:

02.14.21-Health-Advisory-1-Recommendations.pdf (alaska.gov); Appendix C 1-B
COVID-19: Quarantine guidance (alaska.gov); Appendix C 1-C
COVID-19: When to Quarantine | CDC; Appendix C 1-D

Transportation to Field

Field crew members that do not reside in Wrangell (six total) will fly Alaska Airlines to Wrangell and proceed to the Stikine River as quickly as possible and with limited interaction with the Wrangell community and follow all state and local guidelines during travel. Field crew members that reside in Wrangell (five total) will leave from the Wrangell harbor to the Stikine River in individual SOA jet skiffs. Staff start times are staggered and five will jet boat to camp on April 16th, one crew member will be transported by charter jet boat on April 21st and the remaining three crew will come in on SOA skiffs May 1st. Jet boat operators will wear gloves and sanitize surfaces when finished with travel. Staff will clean cloth masks regularly and will be expected to wear them during transportation to and from field and camp and when working with others.

Field crew members will wear masks and disposable gloves when being transported by charter vessels and/or planes. Masks will be assigned to each crew member (at least 2 per person) to be kept for the duration of the project. Staff will clean cloth masks regularly and will be expected to wear them during transportation to and from field and camp and when working with others.

Once in the field, ideally crews will stay in the field and will not return to town until the project is over.

Project leaders will contact community leaders and/or visit the local community website to determine any community health mandates/requirements prior to entry into the local community or start of a project to communicate our intent and how we may address their concerns.

Supply contingencies

There are up to 11 personnel working on this project.

Camps will maintain food supplies adequate for three weeks of normal operation; a weeks' worth of backup supplies will be stored Wrangell.

At least 2 cloth masks per person, one set of safety goggles per person, along with 500+ latex gloves and various cleaning agents will be in camp.

The camp will email grocery lists to City Market weekly, and City Market will deliver groceries to the expeditor in town. Field camp crews will wear latex gloves while offloading the supplies that are stored on the outside deck of the boat; the expeditor will remain in the cabin of the vessel.

Supplies, materials, and personal mail arriving from town once field camps are established shall be quarantined for 72 hours or sanitized prior to use and handling.

Work and Living Protocols

Crew members will maintain 6-foot distancing as much as possible when actual work needs do not require working closer than 6 feet.

Crew members will always practice the Covid-19 protocol with frequent hand washing, sanitization of common areas and equipment, and through wearing of gloves and masks.

Crews will be limited 2-3 people in boats and 3-4 people in the tag shack while working.

In response to Covid-19, crews from DFO Canada are not participating in this project through at least June; however, ADF&G crews have performed this work historically and impacts to the project objectives will be minimal.

If crew members become ill, they will not report to work and they will immediately notify their supervisor. See section "Possible cases of Covid-19 occur in camp."

Crew members will take their temperatures each morning and evening.

Crew members will sleep in individual tents or rooms.

Communication

Crew leader will maintain a list of emergency contacts in town. Kristin Courtney (available in Juneau after 6/1), Juneau, work: (907) 465-4271, cell: (907) 518-0853; Phil Richards, Juneau, work: (907) 465-8114, cell: (907) 723-6141; Ed Jones, Juneau, work: (907) 465-4417, cell: (907) 209-8661; Patrick Fowler, Petersburg, work: 772-5231, cell: (907) 738-2864.

Crew leader and project leader will maintain a list of emergency contacts for all crew members. This list will be on file with the Project leader and in personnel files at the home office.

Graham Gablehouse: David Mork (stepfather) (907) 874-3269

Chris Kamal: Dorothy Kamal (mother) (404) 966-9817

Brendan Jackson: Robert Jackson (father) (608) 606-6058

Kyle Martini: Amy Martini (mother) (513) 659-4259

Stephen Todd: Amber Al-Haddad (spouse) (907) 874-4644

Kristin Courtney: Michael Courtney (spouse) (907) 854-3091

Kiana Putman: Ginger Baim (mother) (907) 414-7077

Michelle Dutro: Siri Dutro (mother) (425) 830-5638

Anna Tollfeldt: Tony Belback (partner) (907) 617-1931

Paul Lecheung: Jeanna Singleton (mother) (912) 856-8966

Lindsey Lorgen-Jones: Marie Lorgen (mother) (425) 232-5053

The project leader will check in daily with Phil Richards, and Kristin Courtney after June 1. The project leader will email crew and project status weekly to ADF&G and DFO offices.

Satellite phones, Satellite Texting devices, and radios will be sanitized between each use.

Transportation Plan Contingency

Crews will stay in camp for duration of project when possible instead of crew swapping.

If crews need to be evacuated, transportation options are: Travel to Wrangell via fixed-wing (Sunrise Aviation, 874-2319), travel by jet boat to Wrangell (Breakaway Adventures, 874-2488) or through use of existing boats on the river, followed by Juneau via helicopter (Coastal Helicopters, 789-5600), followed by fixed-wing to Juneau (Ward Air, 789-9150). If emergency extraction from Canada is required, crew members will take those in need of extraction to the U.S. side of the border for removal by aircraft.

If indications of COVID-19 become evident while in the field, the afflicted will be secluded as best as possible, and plans described below will be followed.

Possible cases of Covid-19 occur in camp

If a crew member becomes symptomatic (fever over 100.3, dry cough, headache), the crew member will immediately be isolated and evacuated to town seeking medical advice and testing. The remaining crew will continue their daily activities.

Prior to evacuation, the patient (if able) or crew leader will keep a daily health log where body temperature and symptoms will be recorded to identify recovery or severity and if necessary, relay accurate information to health professionals.

During extraction, all crew will wear cloth masks and try when possible to maintain 6-foot distancing (at least in boats).

All equipment used will be disposed or sanitized or quarantined before next use.

If extraction is necessary due to suspected Covid-19 illness, at the Director’s discretion the project will be shut down for the year, and the remaining crew will decommission the camp as much as practical prior to evacuation.

APPENDIX C 1-A

Centers for Disease Control and Prevention

When You've Been Fully Vaccinated

How to Protect Yourself and Others

Updated Mar. 23, 2021 Print

COVID-19 vaccines are effective at protecting you from getting sick. Based on what we know about COVID-19 vaccines, people who have been fully vaccinated can start to do some things that they had stopped doing because of the pandemic.

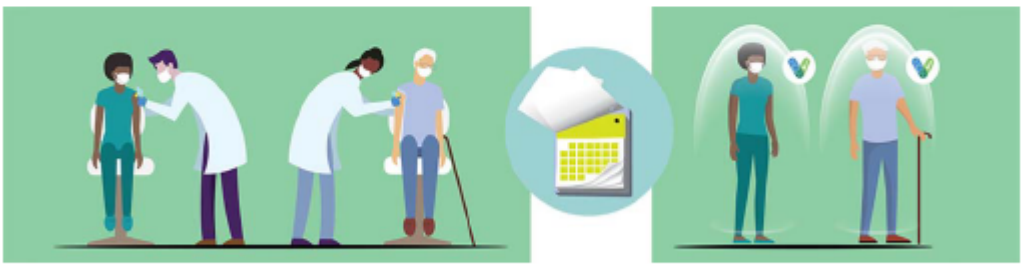
We're still learning how vaccines will affect the spread of COVID-19. After you've been fully vaccinated against COVID-19, you should keep taking precautions in public places like wearing a mask, staying 6 feet apart from others, and avoiding crowds and poorly ventilated spaces until we know more.

Have You Been Fully Vaccinated?

People are considered fully vaccinated:

- 2 weeks after their second dose in a 2-dose series, such as the Pfizer or Moderna vaccines, or
- 2 weeks after a single-dose vaccine, such as Johnson & Johnson's Janssen vaccine

If it has been less than 2 weeks since your 1-dose shot, or if you still need to get your second dose of a 2-dose vaccine, you are NOT fully protected. Keep taking all prevention steps until you are fully vaccinated.



What's Changed

If you've been fully vaccinated:

- You can gather indoors with fully vaccinated people without wearing a mask.
- You can gather indoors with unvaccinated people from one other household (for example, visiting with relatives who all live together) without masks, unless any of those people or anyone they live with has an increased risk for severe illness from COVID-19.

- If you've been around someone who has COVID-19, you do not need to stay away from others or get tested unless you have symptoms.
  - However, if you live in a group setting (like a correctional or detention facility or group home) and are around someone who has COVID-19, you should still stay away from others for 14 days and get tested, even if you don't have symptoms.

What Hasn't Changed

For now, if you've been fully vaccinated:

- You should still take steps to protect yourself and others in many situations, like wearing a mask, staying at least 6 feet apart from others, and avoiding crowds and poorly ventilated spaces. Take these precautions whenever you are:
  - In public
  - Gathering with unvaccinated people from more than one other household
  - Visiting with an unvaccinated person who is at increased risk of severe illness or death from COVID-19 or who lives with a person at increased risk
- You should still avoid medium or large-sized gatherings.
- You should still delay domestic and international travel. If you do travel, you'll still need to follow CDC requirements and recommendations.
- You should still watch out for symptoms of COVID-19, especially if you've been around someone who is sick. If you have symptoms of COVID-19, you should get tested and stay home and away from others.
- You will still need to follow guidance at your workplace.

What We Know and What We're Still Learning

- **We know** that COVID-19 vaccines are effective at preventing COVID-19 disease, especially severe illness and death.
  - **We're still learning** how effective the vaccines are against variants of the virus that causes COVID-19. Early data show the vaccines may work against some variants but could be less effective against others.
- **We know** that other prevention steps help stop the spread of COVID-19, and that these steps are still important, even as vaccines are being distributed.
  - **We're still learning** how well COVID-19 vaccines keep people from spreading the disease.
  - Early data show that the vaccines may help keep people from spreading COVID-19, but we are learning more as more people get vaccinated.
- We're still learning **how long** COVID-19 vaccines can protect people.
- As we know more, CDC will continue to update our recommendations for both vaccinated and unvaccinated people.

Until we know more about those questions, everyone — even people who've had their vaccines — should continue taking basic prevention steps when recommended.

Want to learn more about these recommendations? Read our expanded Interim Public Health Recommendations for Fully Vaccinated People, and corresponding Science Brief, and recommendations for healthcare providers.

Last Updated Mar. 23, 2021
Content source: National Center for Immunization and Respiratory Diseases (NCIRD), Division of Viral Diseases

APPENDIX C 1-B

COVID-19 Response and Recovery
Health Advisory No. 1
Recommendations for Keeping Alaskans Safe

Issued: **February 14, 2021**

By: Commissioner Adam Crum, Alaska Department of Health and Social Services
Dr. Anne Zink, Chief Medical Officer, State of Alaska

COVID-19 poses a risk to all Alaskans. Containing the virus that causes COVID-19 cannot be done through community measures alone; Alaskans must take individual responsibility to protect themselves, their loved ones, and their community.The primary ways to do this are:

- Wearing a cloth face covering/mask when in public settings and when you are around people outside your household.
- Practicing social distancing by avoiding close contact and minimizing time spent indoors with persons outside your household.
- Monitoring your health and staying at home when sick.
- Practicing good hygiene by frequently washing your hands and disinfecting high-touch surfaces in your home andworkplace.

When we reduce the spread of the virus by taking these individual measures, we reduce the need for government intervention.

Wear a cloth face covering/mask

Wearing a cloth face covering is strongly recommended for all Alaskans two years of age and older, other than those with breathing problems and those who cannot remove the covering without assistance. **Face coverings protect those aroundyou, and also offer you some protection.**

- Make sure the face covering is made with at least two layers of fabric and covers both the nose and mouth.
- When removing the face covering, avoid touching the front of the face covering
- *Wash your hands immediately* after removing the face covering and before touching anything else.
- Wash cloth face coverings in hot, soapy, water between every use.
- Be careful to avoid developing a false sense of security when using face coverings.

Practice Social Distancing: Avoid close contact with people who are not in your household

- Put at least six feet of distance between yourself and people who don't live in your household.
- Remember that people infected with the virus, but who do not have any symptoms, can also spread the virus.
- Keeping distance from others is especially important for people who are at higher risk of getting very sick.
- Minimize time indoors with individuals outside your household even if you can maintain a distance of six feet.
- Avoid all gatherings, even small ones, with persons who are not in your household.

Monitor your health and stay home if you are sick

- Be alert for symptoms. Watch for fever, cough, shortness of breath, muscle and body aches, new loss of taste orsmell, and other symptoms of COVID-19.
  - Take your temperature if symptoms develop.
- If you develop symptoms, stay home – even if symptoms are only mild.
  - Consider providing additional protections or more intensive care for household members over 65 or with underlying health conditions.
- Get tested as soon as symptoms start, if you can, and stay away from others until your test results are back.

Practice good hygiene

- Wash your hands often.
- Cover coughs and sneezes.
- Disinfect surfaces like doorknobs, tables, desks, and handrails regularly.
- Increase ventilation by opening windows when able.
- Use noncontact methods of greeting each other.

Additional information

If you test positive

- If you test positive, you need to isolate away from others to keep them safe. "Isolate" is the term used in association with individuals who are sick with, or have tested positive for, the virus that causes COVID-19. Isolation means staying home all the time and keeping away from household members as much as possible. More information is available on the CDC and DHSS webpages.
- For most people with no, or mild, symptoms that are improving, isolation will be for ten days since your symptoms start, or if you never have any symptoms,

ten days since you had your test. Consult with a healthcare provider or public health staff member if you have questions about how long you need to be in isolation.

- You do not need to have a negative test to be cleared from isolation.
- It is very important for people who test positive to notify anyone they may have had contact with while infectious.
- Information on what counts as a "contact" can be found on the CDC webpages.
- If you test positive and are unable to isolate safely, or need resources during your isolation period, contact your local public center.

If you have had close contact with a confirmed case

If you have close contact with a confirmed case, you need to quarantine to keep others safe. "Quarantine" is the term used in association with individuals who have been exposed to someone with the virus that causes COVID-19. Quarantine means staying home all the time and keeping away from household members as much as possible. Information on when and how to quarantine is available on the CDC and DHSS webpages.

- The preferred quarantine period is currently 14 days from the last exposure to a known case, but may be able to be shorter under certain circumstances for contacts who do not develop symptoms. Briefly, those two options apply as follows:
  - Seven-day quarantine with a molecular or antigen test <48 hours before the end of quarantine. Individuals must remain in quarantine until their test results are available.
  - Ten-day quarantine.
- There is some risk of post-quarantine transmission associated with discontinuing quarantine before 14 days. Individuals should continue to monitor themselves for symptoms for a full 14 days after their last contact with a confirmed case.

Testing guidance

- Anybody with symptoms of COVID-19 should be tested.
  - A positive test within 90 days of someone's first infection can be difficult to interpret and needs to be discussed with a medical professional.
- Some people without symptoms should also be tested, including:
  - All close contacts of confirmed COVID-19 patients.
  - Health care workers in hospitals and congregate living settings.
  - Residents in congregate living settings (see DHSS guidance for specific groups) and other high- consequence settings (e.g., people coming into remote communities from areas where COVID-19 is circulating).
  - People who may be at increased risk for infection (discuss with medical professional).

- Please note: People with a prior positive test in the past 90 days, should NOT be re-tested.

- More information can be found in the Alaska Section of Epidemiology's testing guidance.

Travel considerations

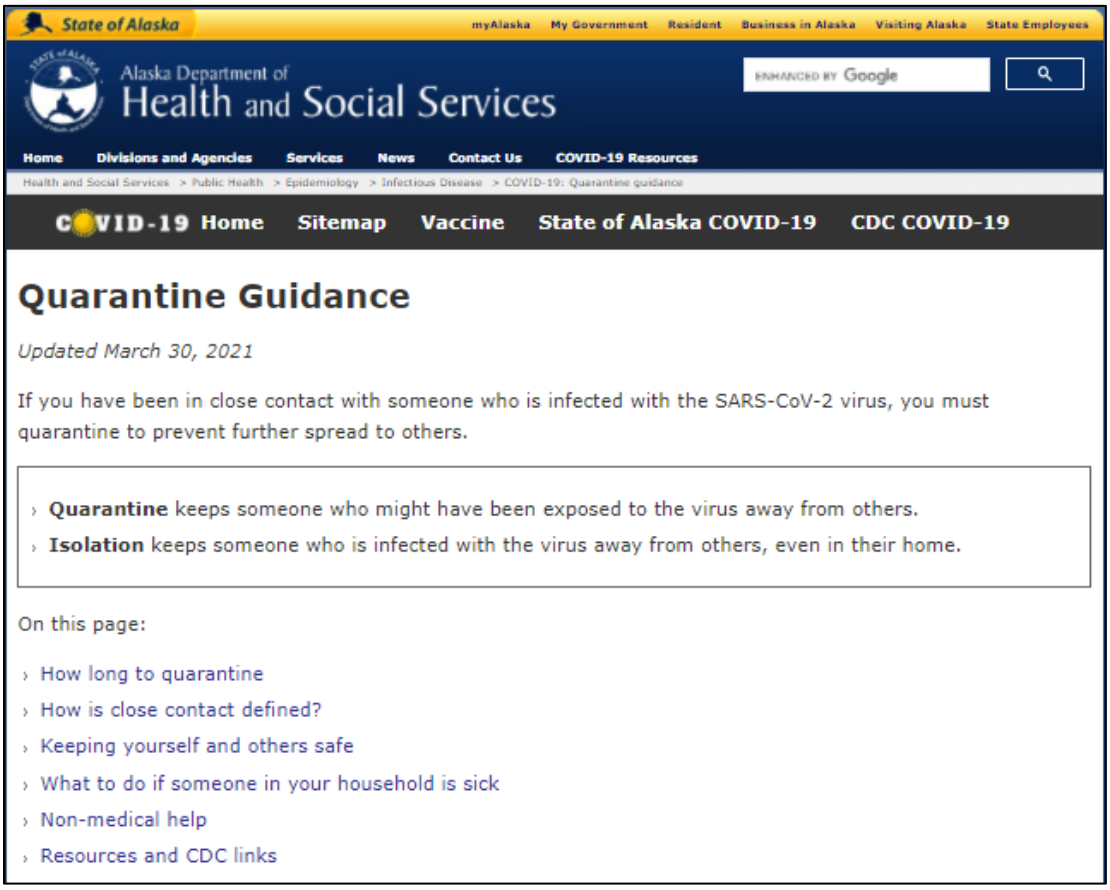
- Follow State of Alaska travel and CDC travel recommendations.
- Assess the risks of travel including the mode of transportation and the level of spread of the virus in the location you will be visiting.
- At-risk individuals and communities with limited health care infrastructure or high-risk populations shouldconsider limiting all non-essential travel.

Special considerations for workplaces, schools and childcare, correctional facilities, and other communitylocations and events are available at https://www.cdc.gov/coronavirus/2019-ncov/community/index.html and http://dhss.alaska.gov/dph/Epi/id/Pages/COVID-19/default.aspx

This is not a mandate.

Visit the State of Alaska's COVID-19 website at coronavirus.alaska.gov for more information

APPENDIX C 1-C



How long to quarantine

According to the U.S. Centers for Disease Control and Prevention (CDC), a 14-day quarantine period is still the safest quarantine duration; however, based on emerging science, CDC has issued updated guidance to provide two acceptable alternatives to shorten the quarantine period.

- If testing is available, you may be able to end your quarantine after 7 days of quarantine, on the 8th day. You can take a COVID-19 test within 48 hours prior when you hope to end your quarantine (on day 6 or 7). You must continue to quarantine until your test comes back negative, which may be longer than 7 days. Even if your test is negative and you end quarantine, you must continue to wear a mask when around others and monitor for symptoms for the full 14 days. If you develop any symptoms or your test result is positive, you must self-isolate.
- If testing is not readily available, quarantine for a full 10 days after you were exposed. You may end your quarantine on day 11 if you do not develop symptoms. You must continue to wear a mask when around others and monitor for symptoms for the full 14 days. Self-isolate if you develop symptoms and get tested.

People who have been in close contact with someone who has COVID-19 are not required to quarantine if they have been fully vaccinated against the disease within the last three months and show no symptoms.

If you are fully vaccinated and have been exposed to someone who has COVID-19, you do not need to quarantine or get tested unless you have symptoms or you live in a group setting (like a correctional or detention facility or group home). Review the complete updated guidelines at the CDC website.

Table: Options to reduce quarantine period

Table. Options to reduce quarantine period for close contacts.

	Option 1	**Option 2**
	7-day Quarantine + Test	*10-day Quarantine*
What type of test is required and when should it be obtained?	Molecular or antigen; specimen must be collected <48 hours before the time of planned quarantine discontinuation (i.e., on day 6 or 7 of quarantine)	No Test Required
Can quarantine be further shortened with a negative test result?	No	No
When is the earliest that a person can be released from quarantine and go back to work or school?	8 days after exposure with a negative test result	11 days after exposure
What should patients do if they haven't gotten their test result back before the time of planned quarantine discontinuation?	Remain in quarantine until they get a negative test result or 10 days have passed, whichever is earlier	No Test Required
Estimated residual post-quarantine transmission risk	5% (upper limit: 12%)	1% (upper limit: 10%)
What added precautions should people take after being released from quarantine under option 1 or 2?	**Take extra precautions until 14 days after exposure**: watch for symptoms, wear a mask when in public areas, avoid crowds, maintain 6-foot distance from others, wash hands frequently, avoid any contact with high-risk persons, discuss with employer whether it is safe to return to work.	

Notes:

1. *The above options are only for contacts who have remained asymptomatic for the entire duration of their quarantine. Anyone who develops symptoms within 14 days of an exposure (regardless of whether or not they remain in quarantine) should immediately self-isolate and seek testing.*
2. *Persons can continue to be quarantined for 14 days per existing CDC recommendations; this option maximally reduces the risk of post-quarantine transmission and is the strategy with the greatest collective experience at present.*
3. *Due to the added risk of transmission associated with reduced quarantine periods, a full 14-day quarantine period is recommended for persons in certain high-risk settings, such as long-term care facility residents and correctional facility inmates. Administrators of such facilities should also consider excluding staff from work for 14 days after exposure, if operationally feasible.*
4. *CDC guidance for health care workers who are close contacts has not changed from the standard 14-day quarantine.*
5. *Local community leadership (e.g., city mayor or Incident Command) may decide to continue a 14-day quarantine for residents of their communities, based on local conditions and needs. Prior to making this decision, community leadership should reach out to the Alaska Section of Public Health Nursing or the Section of Epidemiology to assure unified coordination.*

How is close contact defined?

A close contact is someone who was within 6 feet of an infectious person for a *cumulative total* of 15 minutes or more over 24 hours while the person was infectious. This definition applies regardless of whether the infected person or close contacts were wearing masks.

- The infectious period for COVID-19 starts 2 days before the patient experiences symptoms (or, for patients who show no symptoms, 2 days prior to testing) until the time the patient is isolated.
- Example of cumulative exposure:
  Three separate 5-minute exposures (for a total of 15 minutes) over a 24-hour period.

Keeping yourself and others safe

With cases on the rise in communities across Alaska, public health contact tracers may not be able to notify all close contacts. Because of this, contact tracers are asking people who have tested positive for COVID-19 to begin informing their close contacts of their potential exposure to the virus as soon as possible. The faster people begin to quarantine, the better we can prevent further transmission.

These resources can help you determine your close contacts and know what to say when you call:

- Thank you for getting tested – what to do after your test
- What to do if you have been exposed to COVID-19

If you are in quarantine, stay home, separate yourself from others, monitor your health and follow CDC, state and local health guidance. If you don't have symptoms, other household members do not need to quarantine. However, no visitors should come to your home during this time. If household members need to be in the same room with person in quarantine, everyone should wear a mask and stay six feet apart. Wash hands often and frequently clean and disinfect commonly-touched surfaces.

What to do if someone in your household is sick

Even if you experience very mild symptoms, isolate yourself immediately, call a health care provider and get tested. Isolation separates someone who is sick or tested positive for COVID-19 without symptoms away from others, even in their own home. If you live with others, try to stay in a specific "sick room" or area and away from other people. Use a separate bathroom, if available.

If you do experience symptoms or test positive, others in your household will need to quarantine. Their quarantine period begins on the date they last had close contact with you (before you were able to effectively isolate apart from household members). Any time a new household member gets sick with COVID-19 and others in the household have had close contact with that person, household members will need to restart their quarantine.

If you live in a household and cannot avoid close contact with family members or roommates who have COVID-19, you should avoid contact with others outside your home while the person is sick. Your quarantine period begins when the person who has COVID-19 meets the meets the criteria to end home isolation.

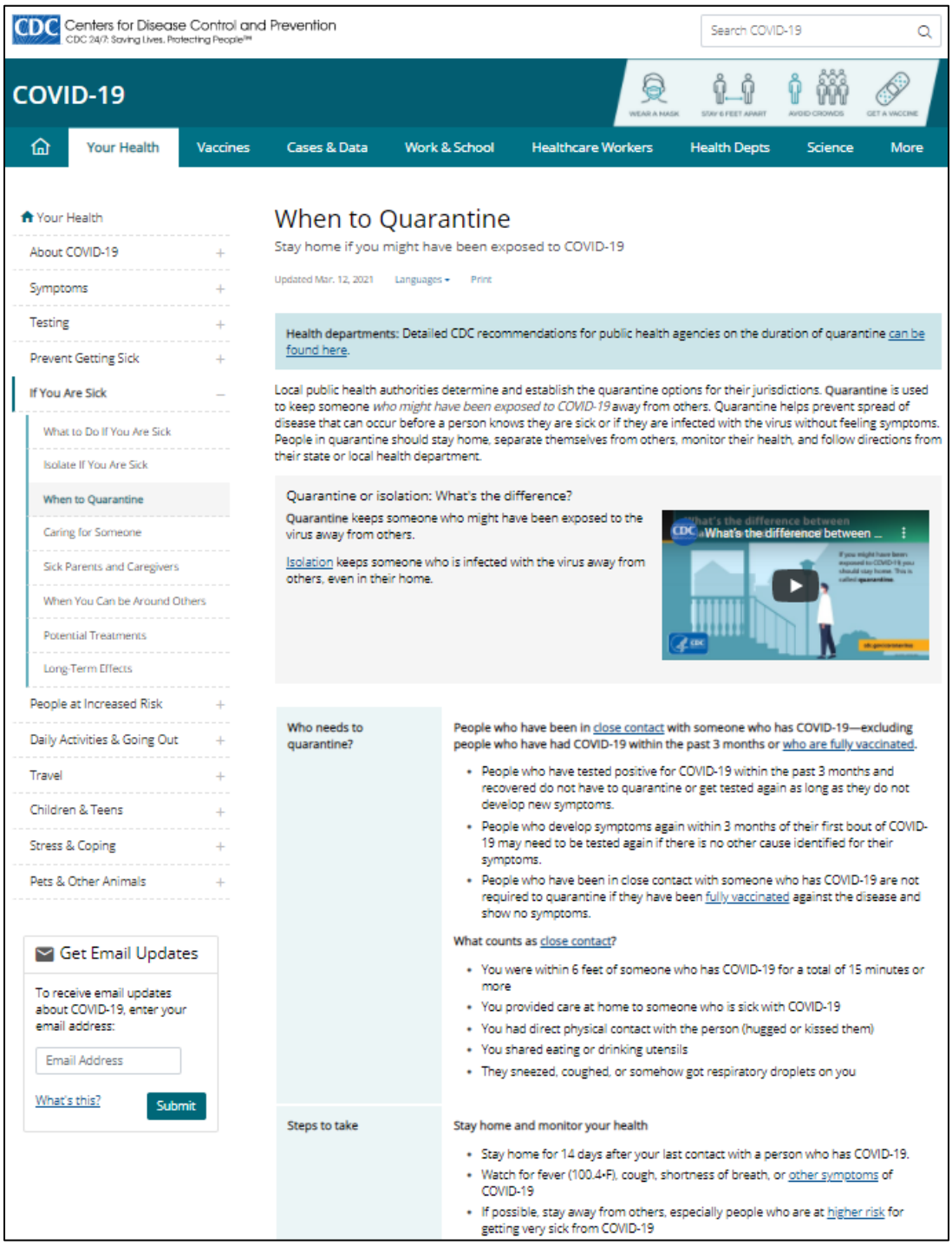
Non-medical help

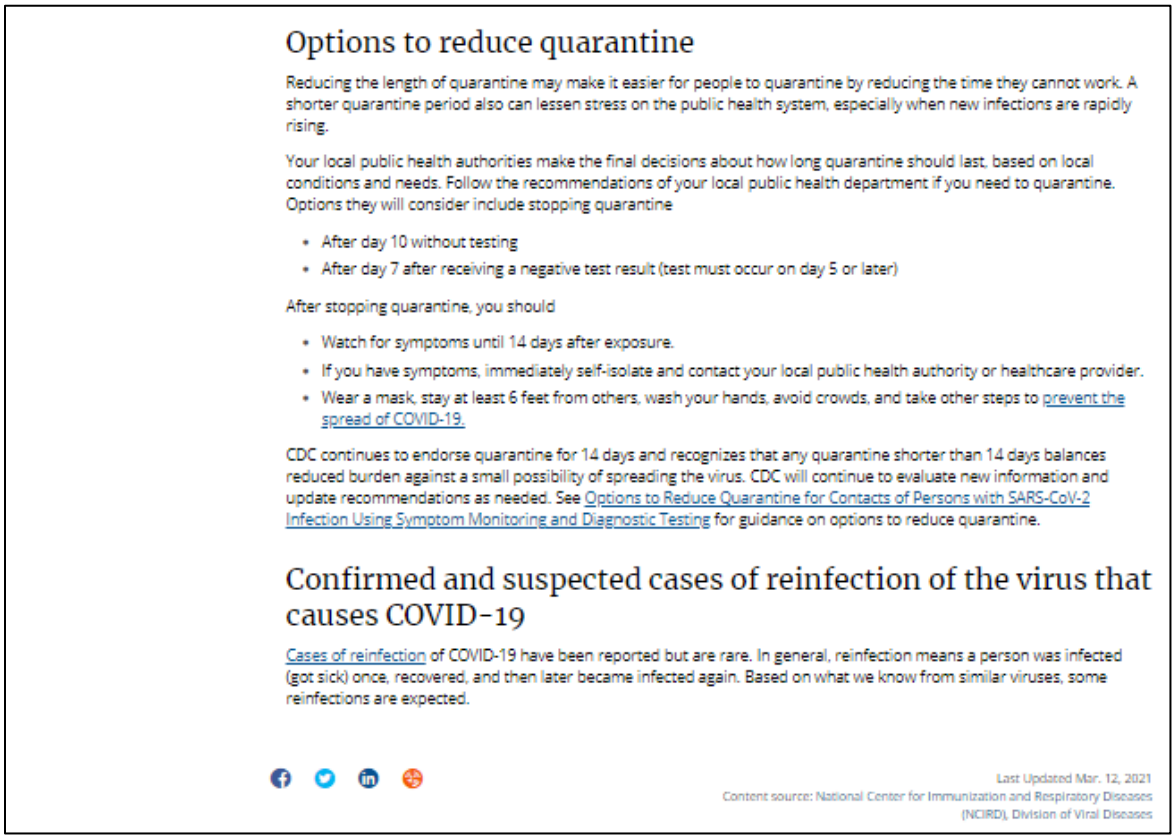
If you need non-medical help to successfully quarantine or isolate (e.g., groceries or other support) call 2-1-1 or 1-800-478-2221.

Resources and CDC links

- Letter template for returning to school or work after quarantining
- Options to Reduce Quarantine for Contacts of Persons with SARS-CoV-2 Infection Using Symptom Monitoring and Diagnostic Testing (CDC)
- When to Quarantine (CDC)
- What to Do If You are Sick (CDC)
- Isolate if You are Sick (CDC)

Appendix C 1-D





Options to reduce quarantine

Reducing the length of quarantine may make it easier for people to quarantine by reducing the time they cannot work. A shorter quarantine period also can lessen stress on the public health system, especially when new infections are rapidly rising.

Your local public health authorities make the final decisions about how long quarantine should last, based on local conditions and needs. Follow the recommendations of your local public health department if you need to quarantine. Options they will consider include stopping quarantine

- After day 10 without testing
- After day 7 after receiving a negative test result (test must occur on day 5 or later)

After stopping quarantine, you should

- Watch for symptoms until 14 days after exposure.
- If you have symptoms, immediately self-isolate and contact your local public health authority or healthcare provider.
- Wear a mask, stay at least 6 feet from others, wash your hands, avoid crowds, and take other steps to prevent the spread of COVID-19.

CDC continues to endorse quarantine for 14 days and recognizes that any quarantine shorter than 14 days balances reduced burden against a small possibility of spreading the virus. CDC will continue to evaluate new information and update recommendations as needed. See Options to Reduce Quarantine for Contacts of Persons with SARS-CoV-2 Infection Using Symptom Monitoring and Diagnostic Testing for guidance on options to reduce quarantine.

Confirmed and suspected cases of reinfection of the virus that causes COVID-19

Cases of reinfection of COVID-19 have been reported but are rare. In general, reinfection means a person was infected (got sick) once, recovered, and then later became infected again. Based on what we know from similar viruses, some reinfections are expected.

Last Updated Mar. 12, 2021
Content source: National Center for Immunization and Respiratory Diseases (NCIRD), Division of Viral Diseases