The Kitsumkalum River Chinook salmon Project 2017

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CONTENTS

LIST OF TABLES

LIST OF APPENDICES

ABSTRACT

Winther, I. 2017. The Kitsumkalum River Chinook Program 2017. Unpublished report for the Pacific Salmon Commission Northern Boundary and Transboundary Rivers Restoration and Enhancement Fund 2017. File # NF-2017-VHP-12: iv + 25 p.

Fisheries & Oceans Canada has conducted an annual key stream program since 1984 to generate the data necessary to use Kitsumkalum River Chinook salmon *(Oncorhynchus tshawytscha)* as an indicator stock for the North Coast of British Columbia. Preliminary estimates were generated for 2017. The 2017 program estimated the population size of Chinook salmon returning to the Kitsumkalum River at 4,943 fish older than age 3_2. The coefficient of variation around the escapement estimate was 16.5%. This was the lowest escapement estimate since the program was initiated in 1984. The hatchery contribution to the 2017 return was estimated to be 689 Chinook salmon.

The Kitsumkalum River Chinook salmon project produces fry to be marked with coded wire tags for release as fry and yearlings. The project produced approximately 200,000 fry from the 2017 brood.

INTRODUCTION

Funding for this project was provided by the Pacific Salmon Commission's Northern Boundary and Transboundary Rivers Restoration and Enhancement Fund (Northern Fund) to estimate Chinook salmon (*Oncorhynchus tshawytscha*) returning to the Kitsumkalum River in 2017, to collect brood stock for the production of fry to be marked with coded wire tags (CWT's). This report presents preliminary estimates of the Chinook salmon escapement to the Kitsumkalum River in 2017 and provides details on the fish production from the 2017 brood. The results are part of a continuing project to provide an exploitation rate indicator for the North Coast of British Columbia. This document fulfills the reporting requirements for the 2017 Northern Fund project. The PSC Northern Fund elected to fund a portion of the project and the contributions were used for approximately half of the annual contract with the Terrace Salmonid Enhancement Society. Other components of the project were funded by Fisheries & Oceans Canada.

The primary objectives of this study were to estimate the wild and hatchery contributions to the return of Kitsumkalum River Chinook salmon in 2017 and produce Chinook salmon fry from the 2017 brood. The Kitsumkalum River Chinook salmon project generates the escapement data and produces the marked fish required for a PSC exploitation rate indicator stock. The project includes collection of brood stock, production of yearling and sub-yearling Chinook salmon fry, marking the fry with coded wire tags (cwt's) and adipose fin clips, releasing the fry, estimating the wild and enhanced returns and determining the age composition of the returns. This document reports on the escapement estimation and brood stock collection portions of the program.

The Kitsumkalum River Chinook project objectives include the production of approximately 200,000 fry and 60,000 yearlings marked with coded wire tags (CWTs) and adipose fin clips. The marked fish are released into the natural population. The project assesses the Chinook salmon returning to the Kitsumkalum River annually and estimates the hatchery (marked) and wild (unmarked) components of the return and the age structure of the population. The international Mark Recovery Program samples fisheries for coded wire tagged fish in Canada and the United States. The data from the project are essential to measure exploitation rates and for run reconstruction calculations.

The scope of the Kitsumkalum River Chinook project is broad with impacts ranging from local to international. The results from the escapement assessment program are measured against the Pacific Salmon Commission (PSC) data standards. The project contributes internationally as an exploitation rate indicator stock in the PSC Chinook model. Additionally the estimates from the Kitsumkalum project provide the basis for expansions to generate escapement estimates for Chinook populations in the Skeena River which is a PSC escapement indicator stock. Domestically the data contribute to Canada's Key Stream Program and provide the only exploitation rate indicator stock for Chinook salmon in the North Coast.

Kitsumkalum Chinook salmon are encountered in the PST Aggregate Abundance Based Management (AABM) fisheries in Southeast Alaska (SEAK all gear) and Northern British Columbia (NBC Troll and Haida Gwaii (QCI) Sport). They also contribute to the Individual Stock Based Management (ISBM) fisheries in Northern British Columbia including gillnet, tidal sport, non-tidal sport, tidal First Nations' (FN) and non-tidal FN fisheries. They are north migrating so they do not contribute to the West Coast Vancouver Island (WCVI) AABM fisheries nor do they contribute appreciably to ISBM fisheries south of the Skeena River.

Chinook salmon returns to the Skeena River have been estimated using the proportion of Kitsumkalum River fish measured from genetic samples collected at the Tyee test fishery and

estimates of the Kitsumkalum Chinook salmon escapement. Preliminary estimates are available from 1984 to 2016 as a result of PSC Northern Fund and Sentinel Stock projects. The genetic-based estimates represent an improvement over the historic indices since they include estimates of variance which cannot be produced for the historic indices. Also, comparisons between years are valid since the method is consistent across the time series whereas methods used for the historic indices varied through time.

METHODS

Chinook salmon escapements to the Kitsumkalum River are assessed through a two event mark recapture procedure that collects the data necessary to provide estimates of the wild and enhanced fractions of the escapement. Gender specific data are essential in the mark application and mark recovery portions of the work. Scales are collected to provide the age data necessary to identify the brood year components of the return. Scales are matched to size, gender and capture information and individual encounter histories are generated for all Chinook salmon encountered.

In the first event Chinook salmon are caught using tangle nets drifted through spawning and holding reaches of the river. Fish are marked with Kurl lock tags and given a mutilation mark consisting of a 7mm hole punched through the operculum. This tagging event typically occurs from 17 August to 12 September. The second event consists of a dead pitch where carcasses are recovered and checked for marks. The dead pitch occurs through the duration of the die-off after spawning, usually from 15 September to 10 October. Additional details regarding the 2017 program appear in the contract report provided by the Terrace Salmonid Enhancement Society (Appendix 1). Heads are recovered from adipose fin clipped fish encountered in both events and CWT's are extracted and read as part of a separate contract.

The mark re-capture estimate of Chinook salmon to the Kitsumkalum River consisted of simple Petersen estimates of the form:

$$N_{sr} = \frac{(M_{sr}+1)(C_{sr}+1)}{(R_{sr}+1)}$$

Where N is the estimate of large Chinook salmon, M is the number of large Chinook salmon marked, C is the total number of large Chinook salmon carcasses encountered in the dead pitch and R is the number of marked large Chinook salmon carcasses recovered in the dead pitch by sex (subscript s) and river reach (subscript r) (Ricker, 1975). Separate estimates were calculated for males and females. Variance was computed using:

$$v(N_{sr}) = N_{sr}^2(C_{sr}-R_{sr})/(C_{sr}+1)(R_{sr}+2)$$

RESULTS

The preliminary estimate of the population size of Chinook salmon returning to the Kitsumkalum River was 4,943 fish older than age 3_2. The coefficient of variation around the escapement estimate was 16.5% (Table 1.)

The hatchery contribution to the 2017 return was estimated to be 689 Chinook salmon.

The Kitsumkalum River Chinook salmon project produced approximately 200,000 fry to be marked with coded wire tags early in 2018. Additional details appear in Appendix 1.

DISCUSSION

The purpose of this project was to estimate the wild and hatchery contributions to the return of Chinook salmon to the Kitsumkalum River in 2017 and produce approximately 260,000 Chinook salmon fry from the 2017 brood.

The 2017 escapement estimate for Chinook salmon in the Kitsumkalum River was the lowest return on record since the mark-recapture program was initiated in 1984. Obtaining fish during the tag and recovery events were difficult given the low population size. While the resulting CV of 16.5% is above the data standard of 15% it is lower than expected given the record low population size.

The project was challenged to collect enough ripe females to meet the objective of 290,000 eggs. Ultimately approximately 210,000 eggs were collected from 35 females which resulted in approximately 200,000 fry at the time of writing.

The data from the 2017 Kitsumkalum program will be used to estimate Chinook salmon returns to the Skeena River using the proportion of Kitsumkalum River fish measured from genetic samples collected at the Tyee test fishery.

ACKNOWLEDGEMENTS

The Terrace Salmonid Enhancement Society conducted the mark recapture work and the fish production work as part of a contract with Fisheries and Oceans Canada. The hatchery manager, team leader and author of the annual report was Ian Riemenschneider. The report is presented here as Appendix 1.

REFERENCES

MacLellan, S.E. 1999. Guide for sampling structures used in age determination of Pacific salmon. Fisheries & Oceans Canada, Stock Assessment Branch, Pacific Biological Station, Nanaimo, British Columbia.

Pacific Salmon Commission. 2000. Pacific Salmon Treaty, 1999 Revised Annexes, Memorandum of Understanding (1985), Exchanges of Notes.

Ricker, W.E. 1975. Computation and Interpretation of Biological Statistics of Fish Populations. Bulletin 191. Department of the Environment, Fisheries and Marine Service, Pacific Biological Station, Nanaimo, British Columbia.

TABLES

Table 1. Chinook salmon mark recovery details and preliminary estimates for the 2017 Kitsumkalum River Chinook salmon program.

2017 Kitsumkalum Chinook	Upper Males	Upper Females	Lower Males	Lower Females
Total Live fish examined tagging	142	73	249	104
Adipose fin clips observed tagging	16	5	67	15
Live adipose fin clip removals	16	5	67	15
Live brood stock removals	0	21	0	14
Tagged releases M	126	47	182	75
Dead examined C	49	48	145	141
Adipose fin clips observed dead	2	5	22	10
Total marked recoveries R	3	4	15	7
Same reach marked recoveries R	3	4	13	7
Other reach marked recoveries - Strays	0	0	2	0
Correction to C for Strays	0	0	19	0
C corrected for strays	68	48	126	141
R corrected for strays	5	4	13	7

2017 Kitsumkalum Chinook	Upper Males	Upper Females	Lower Males	Lower Females	Total
Tagged releases M	126	47	182	75	
Total Dead pitched C	68	48	126	141	
Dead pitch recoveries R	5	4	13	7	
Petersen estimate	1,468	470	1,656	1,349	4,943
Variance	281,049	33,116	162,560	190,809	667,533
Standard Deviation	530	182	403	437	817
Adipose fin clip contribution	138	39	374	138	689

APPENDICES

Appendix 1. 2017 Kitsumkalum River Project report by Ian Riemenschneider, Terrace Salmonid Enhancement Society.

Kitsumkalum River Chinook Salmon Key-Stream Project (2017)

Submitted to: Ivan Winther
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Date: November 3rd, 2017

This summary was completed in fulfillment of the adult tagging and recovery procedures reporting requirements for Fisheries and Oceans Canada service contract: F5211-160692.

Abstract

The Terrace Salmonid Enhancement Society (TSES) operates the Deep Creek Hatchery and conducts the Kitsumkalum Adult Chinook Salmon Tagging and Carcass Recovery (Mark recapture program) under contract with Fisheries and Oceans Canada. In 2017, a total of *475* wild Chinook were marked with Kurl Lock tags and opercular punches and *75* of these individuals were recaptured at least once (to a maximum of *5* times). There were 356 male (75%) and 119 female (25%) wild Chinook tagged and released. There were 316 'large' male Chinook (>45cm *POH*) and 40 'jack' males (<46cm *POH*). Thirty-five (35) females encountered during the tagging program were sacrificed for brood stock. A total of 110 CWT Chinook were captured comprising of 90 males (82%) and 20 females (18%). Chinook possessing CWTs made up approximately 18% of the total catch during live tagging (not including incidental species). A total of 392 wild Chinook carcasses and 40 CWT Chinook carcasses were sampled during tag recovery efforts. Of wild Chinook, 174 were female (44%) and 218 were male (56% including 47 jacks). Thirty (30) possessed kurl lock tags or opercular punches (11 females, 18 large males, and 1 jack male) placed by the live tagging crew.

Table of Contents

List of Figures

List of Tables

INTRODUCTION

The Terrace Salmonid Enhancement Society (TSES) operates the Deep Creek Hatchery and conducts the Kitsumkalum Chinook salmon Project under contract with Fisheries and Oceans Canada. This document reports the conduct and preliminary results for the mark-recapture portion of the project to estimate Chinook salmon spawning escapement and hatchery contribution.

The program produces coded wire tag (CWT) marked Chinook salmon (*Oncorhynchus tshawytscha*) fry and yearlings which are released into the natural population. The objective is to assess Chinook salmon returning to the Kitsumkalum River annually and provide data that can be used to estimate hatchery and wild components of the return, as well as the age structure of the population. Coded wire tagged fish are sampled in an international Mark Recovery Program, data that is essential to measuring exploitation rates and run reconstruction calculations. The Kitsumkalum River is the exploitation rate indicator stock for the Skeena Chinook salmon complex and spawning escapements have been estimated using this mark-recapture program since it's initiation in 1984 (Winther, 2013).

Winther (2013) estimated the proportion of Kitsumkalum River Chinook salmon in the Skeena River from genetic samples collected at Tyee and used escapement estimates of Kitsumkalum Chinook salmon to estimate the total numbers of Chinook salmon returning to the Skeena River annually. On average, the Kitsumkalum indicator stock represents approximately 18% of the Skeena River Chinook salmon return.

The objectives of the mark-recapture program included tagging 1500 Chinook salmon and recovering 1500 carcasses to be examined for tags. These tagging and recovery objectives have also been expressed in terms of minimum levels of effort for periods of low abundance or extreme environmental conditions. The primary goal was to provide the data necessary for generating gender specific estimates of escapement with a coefficient of variation less than 10%. During the program, adults are collected for brood stock to yield approximately 290,000 eggs for incubation in Deep Creek hatchery. The production objectives were to release 200,000 fry and 60,000 yearling Chinook salmon marked with CWT's and adipose fin clips annually. Each year the continued rearing and release of Chinook salmon fry from the previous year (yearlings) as well as the annual brood production for the current year takes place.

STUDY AREA

The Kitsumkalum River drains an area of approximately 2180 km^2 and flows 100km south to its confluence with the Skeena River in Terrace, BC (McNicol, 1999). High turbidity is often associated with this watershed as considerable glacial runoff occurs during the spring and fall months. Five Pacific salmon species, as well as steelhead (*Oncorhynchus mykiss*), are known to spawn in this system.

Commercial logging activity that occurred in the 1940's and 1950's had a large impact on the morphology of the river. Channelizing efforts by way of dykes and rock and log cribbing

blocked off side channels, removed gravel bars, and subsequently removed spawning and rearing habitat (McNicol, 1999). Presently, the majority of the original dikes still remain.

For the purpose of this work, the Kitsumkalum River is broken into two reaches. The upper reach extends from the outlet of Treston Lake downstream approximately 22 kilometers to a 'mini' canyon. The lower reach starts at the outlet of the lower canyon and extends downstream approximately 10 kms to the confluence with the Skeena River (Andrew and Webb, 1988) (*Figure 1*).

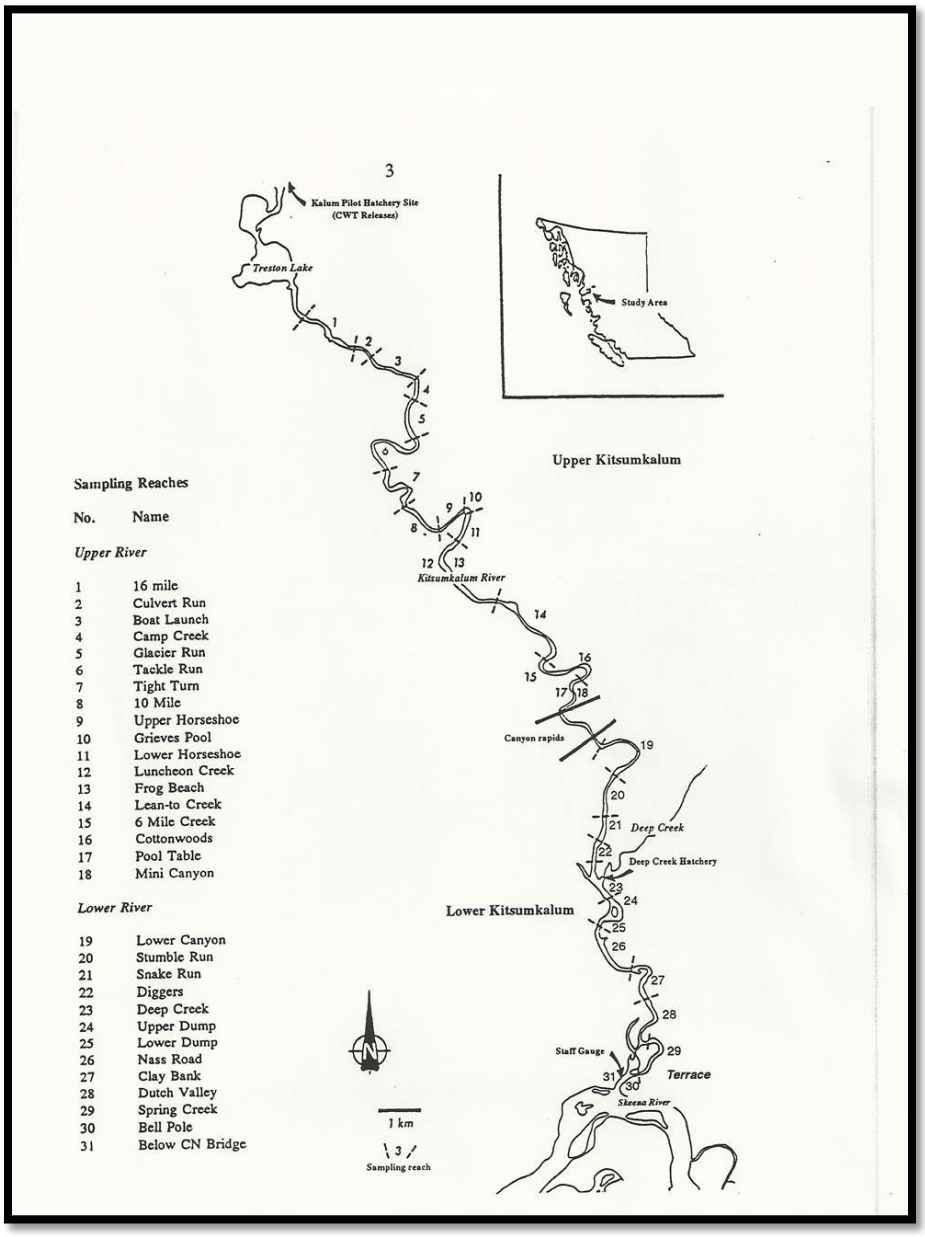

Figure 1. *Map of Kitsumkalum River study area (Andrew and Webb,1988).*

METHODS AND MATERIALS

TAGGING

The tagging program commenced in mid-August and continued until the spawning population began to die off in mid September. Nylon tangle nets 24m long and 5m deep with mesh sizes ranging from 7 to 7.5 inches were fished from a jet boat through spawning and holding areas, and retrieved on shore. Tagging occurred throughout the spawning range of the lower and upper reaches and attempted to apply tags to a representative portion of the Chinook salmon spawning population. The upper and lower river reaches were generally sampled on alternate days unless one river reach had yielded significantly higher catches than the other, at which time more effort could be allocated to that reach.

The fish were marked with Kurl Lock tags and a secondary mutilation mark consisting of a hole punch through the operculum (using a heavy duty paper punch). The tag was placed on the left operculum for fish captured in the lower river reach and on the right operculum for fish captured in the upper river reach. The hole punch was placed next to the tag on the applicable side to allow for detection of tag losses.

Data collected for fish captured included date, location, set number, gender, post-orbital hypural (POH) length, presence or absence of an adipose fin clip, data on whether it was killed or released, tag number, punch location, and scale sample information are recorded. If an individual was recaptured, the date, location, set number, gender, punch location and tag number. The sampling objective for the collection of scales was to sample 500 fish encountered during the live tagging portion of the project and 500 fish from the carcass recovery portion of the project. Scales from Chinook salmon were placed in specialized scale booklets for aging (MacLellan, 1999). Five scales were taken from each donor and individuals were selected randomly so that the sample represented the catch.

All Chinook encountered with an adipose fin clip, which indicates the presence of a CWT, were sacrificed with the exception of one individual that was marked with Kurl Lock tag and released. Scales were collected and the heads were retrieved for dissection. Heads were identified with a unique label.

Catch-per-unit-effort (CPUE) was calculated (*Table 1*) for each netting site, indicating the average number of Chinook salmon caught per net set, including tagged, brood females kept, and CWT Chinook (possessing an adipose clip). Recaptures were not included in the CPUE formula.

BROOD COLLECTION

In order to obtain 290,000 eggs for incubation, the collection of 35 to 50 brood females was required (depending on fecundity) during the mark-recapture program. Sperm was collected from two males per brood female. Males were selected randomly to avoid any bias associated with the size of the fish. An attempt to collect 50% of brood stock from the upper river and 50% from the lower river was made with the intention of genetically representing the entire population.

Ripe females were observed in early to mid-September and eggs were collected from these individuals in an attempt to meet the brood objective. Upon capture, females were examined for ripeness. Green females appearing to be within 2 days of optimal ripeness for

gamete collection were held in submersible bags secured to bank structure until they could be retrieved the following sampling day on the respective river reach. Ripe females selected for brood stock collection were killed, hung, and bled out to allow the eggs to be devoid of any blood. Eggs were taken through an incision made in the body cavity, and placed in zip-lock bags. Sperm was taken from live males selected for brood stock, which were tagged and released, placed in whirl bags and a cooler with ice. Gametes were transported using a second jet boat fitted with a cooler suspended by rubber bungee cords. This suspension reduced jarring movements during transport which can harm unfertilized eggs. Precautions were taken to avoid exposing the gametes to contact with direct sunlight using tarps and umbrellas. Equipment and tools used in this process are cleaned and sterilized with ovadine after each fish to avoid contamination of each sample.

Each female collected for brood stock was screened for the presence of *Renibacterium salmoninarum,* which can cause bacterial kidney disease (BKD), to ensure infected offspring are not reared in the hatchery facility. A sterilized knife was used to take a sample of the kidney, which was placed in a whirl bag using latex gloves. The sample was frozen each day upon returning to the hatchery. BKD samples were shipped to a Fisheries and Oceans Canada veterinarian for analysis once the brood stock collection was complete.

Biological data recorded for brood stock included length, gender, scale sample numbers, and fish number in order to identify mated fish.

TAG RECOVERY

Carcasses were recovered as soon as they become available and recovery continued until no new carcasses were available. Generally, carcasses begin to appear in mid-September and continue to appear until mid-October. The objective of recovering 1500 carcasses is also expressed a minimum of 20 working days required during this component of the program. Carcasses were examined for tags, opercular punches, and pre-spawn mortality, which was documented in addition to length and gender. Wooden poles fixed with metal hooks were used to gaff carcasses under water. Pruning shears are used to remove the tail after sampling to distinguish carcasses that have been sampled. Heads were collected from carcasses with an adipose fin clip. Scale samples were collected if decomposition of the body was not advanced. The scale sampling objective was to collect scales from 500 carcasses. Heads were collected from fish with adipose fin clips and all CWT heads were shipped to J.O Thomas and Associates for analysis after the field program was complete.

RESULTS

TAGGING

The tagging component of the program commenced on August 14th, 2017 and continued until the last Chinook salmon was tagged on September 20th 2017. Tagging efforts ceased when more dead Chinook were obtainable than alive. Water heights were not ideal (very high) throughout most of the live tagging component and the tag recovery component experienced a dramatic increase on September 26th and remained unfavorable until October 3rd (*Figure 2*).

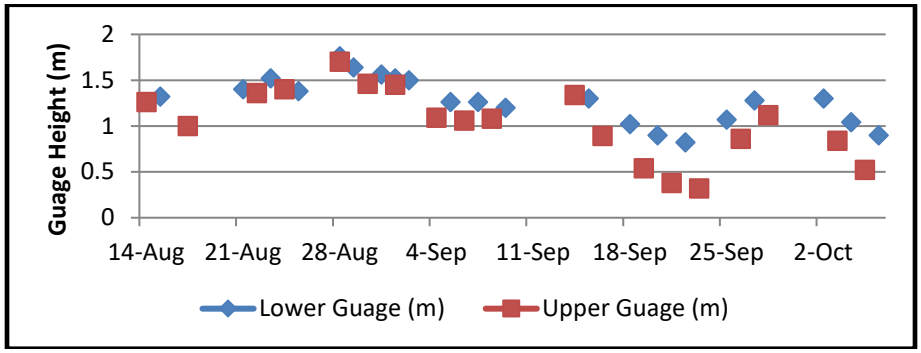

Figure 2. *Kitsumkalum River water height(m) at lower and upper reach gauges in 2017.*

A total of *475* wild Chinook were marked with Kurl Lock tags and opercular punches and *75* of these individuals were recaptured at least once (to a maximum of *5* times). One (*1*) additional CWT Chinook was intentionally marked with a Kurl Lock tag and released. More wild Chinook were tagged in the lower reach (285) than in the upper reach (190), and more CWT Chinook were captured in the lower reach (87) than in the upper reach (23). There were 356 male (75%) and 119 female (25%) wild Chinook tagged and released. There were 316 'large' male Chinook (>45cm *POH*) and 40 'jack' males (<46cm *POH*). Thirty-five (35) females encountered during the tagging program were sacrificed for brood stock (*Table 1*).

A total of 110 CWT Chinook were captured and their heads were removed and sent to J.O Thomas and Associates Ltd. for collection of CWTs. More CWT Chinook were captured in the lower reach (87) than in the upper reach (23) (*Table 1*). There were 90 males (82%) and 20 females (18%). Chinook possessing CWTs made up approximately 18% of the total catch (including brood females and not including incidental species).

Scale samples were collected from 365 wild Chinook and all 110 CWT Chinook encountered in the tagging portion of the program.

Table 2. *Total catch and effort summary by reach in 2017, (live tagging component).*

	Reach	# of	Tagged (Wild)			Brood	CWT			Recaptures (total tag encounters)			CPUE	CPUE
		Sets	Male	Female	C/b	Females	Male	Female	C/b	Male	Female	C/b	Wild	CWT
Upper River	**3**	52	49	19	68	6	10	5	15	17	6	23	1.42	0.29
	6	35	31	6	37	6	0	0	0	13	2	15	1.23	0.00
	9	37	64	16	80	9	8	0	8	10	3	13	2.41	0.22
	10	22	2	3	5	0	0	0	0	0	0	0	0.23	0.00
	11	3	0	0	0	0	0	0	0	0	0	0	0.00	0.00
	12	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
	Total	149	146	44	190	21	18	5	23	40	11	51	1.42	0.15
Lower River	**21**	2	0	1	1	0	0	0	0	0	0	0	0.50	0.00
	22	2	3	1	4	0	1	0	1	0	0	0	2.00	0.50
	23	50	25	14	39	1	46	14	60	2	1	3	0.80	1.20
	24	25	83	20	103	6	19	0	19	47	12	59	4.36	0.76
	25	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
	26	16	0	3	3	0	0	0	0	0	0	0	0.19	0.00
	27	53	34	13	47	1	2	0	2	2	1	3	0.91	0.04
	30	27	65	23	88	6	4	1	5	16	7	23	3.48	0.19
	31	6	0	0	0	0	0	0	0	0	0	0	0.00	0.00
	Total	181	210	75	285	14	72	15	87	67	21	88	1.65	0.48

Sample sites in the lower reach were more productive (CPUE=1.65) than the upper reach (CPUE=1.42) for wild Chinook (*Table 1*). The lower reach was more productive (CPUE=0.48) than the upper reach (CPUE=0.15) for CWT Chinook. The highest catch rate for wild Chinook in the upper river was located at reach 9 (CPUE=2.41) and at reach 3 for CWT Chinook (CPUE=0.29). The highest catch rate for wild Chinook in the lower river was located at reach 24 (CPUE=4.36) and at reach 23 (CPUE=1.20) for CWT Chinook.

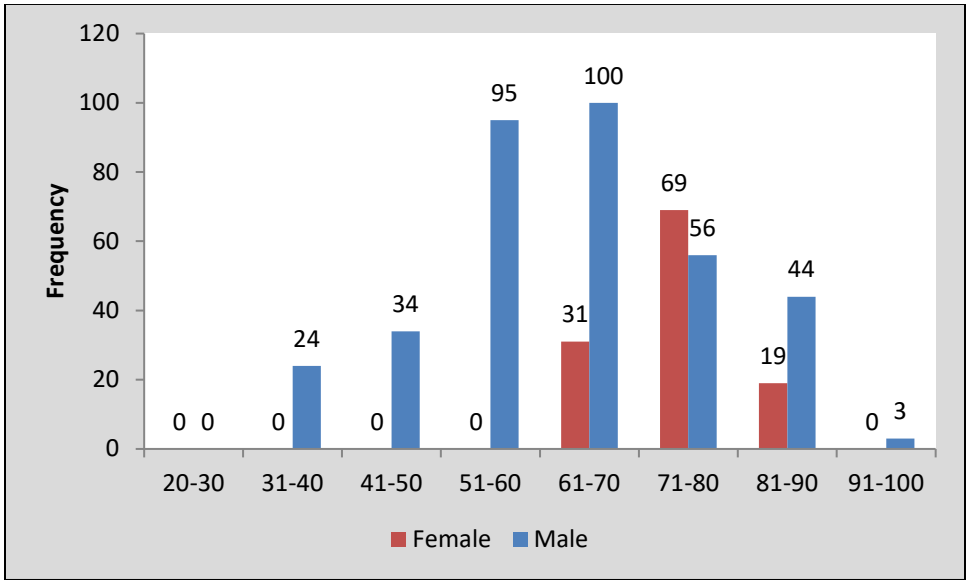

Figure 3. *POH length (cm) distribution of tagged wild Kitsumkalum Chinook salmon (475), including 'jack' males, in 2017.*

Wild female Chinook were most commonly in the 71-80cm length class, while males were relatively evenly distributed between the 51-60cm and 61-70cm length classes. Males were observed to have a greater range in size (*Figure 3*).

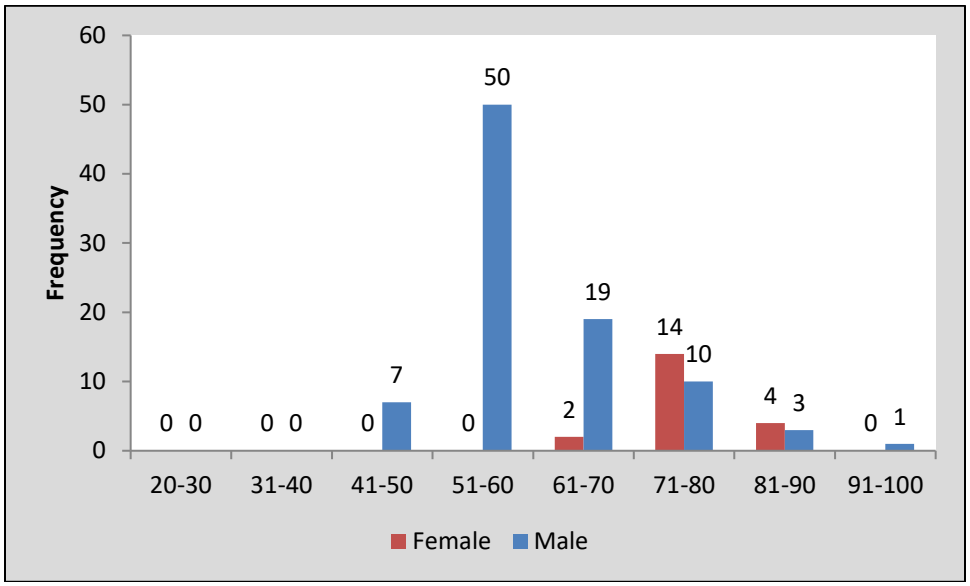

Figure 4. *POH length (cm) distribution of Kitsumkalum Chinook salmon possessing adipose clips (110) captured live in 2017.*

CWT female Chinook were most common in the 71-80cm length class and males were most common in the 51-60cm length class. As seen in the wild Chinook (*Figure 3*), males were observed to have a greater range in size (*Figure 4*).

Table 3. *Mean, minimum, and maximum POH lengths(cm) of 'large' wild (tagged) and CWT Chinook salmon by sex in 2017.*

	Female			Male (>45cm POH)		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Wild	75	64	90	67	46	97
CWT	76	67	87	61	46	100

POH lengths were measured for 119 wild female, 316 'large' wild males (356 including jacks), 20 CWT females, and 87 large CWT males (90 including jacks). Jacks were not included in *Table 2*, however, the mean length of females remained larger than males in both wild and CWT Chinook.

BROOD COLLECTION

Thirty five (35) females were collected for brood stock during the tagging program. Twenty-one (21) were collected from the upper reach and 14 from the lower reach. The first female and accompanying males were collected for brood stock on September 4th, and the last brood stock collection occurred on September 19th.

Brood females collected during this two week period provided an estimated ~170,000 eggs for incubation in Deep Creek Hatchery. Screening results determined that no fish ranked positive for BKD (*Appendix B*).

TAG RECOVERY

Tag recovery efforts began September 15th when the first carcass was discovered and continued until October 6th (*Figure 5*).

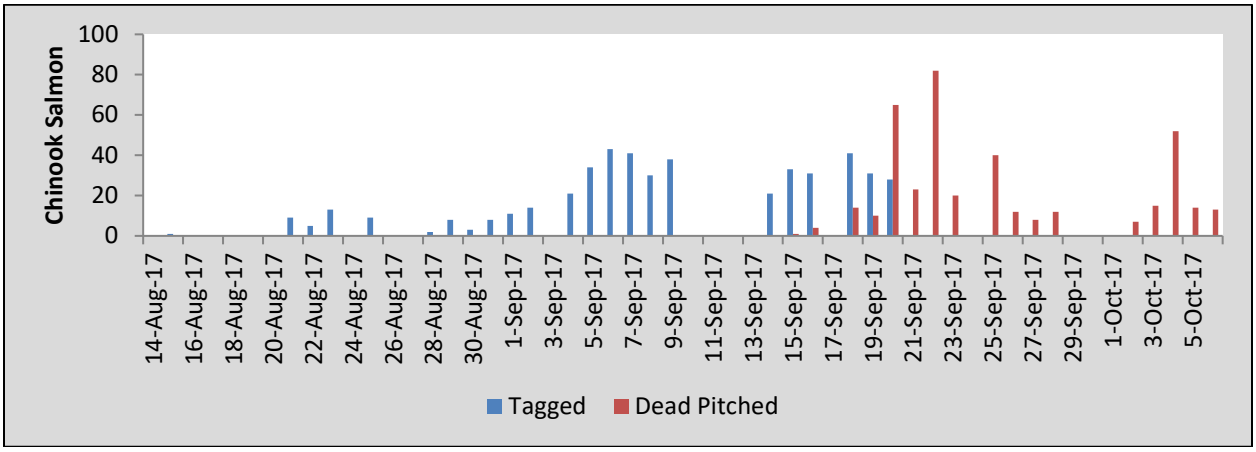

Figure 5. *Frequency distribution of wild Chinook salmon tagged (475) and wild carcasses sampled (392) in 2017.*

A total of 392 wild Chinook carcasses and 40 CWT Chinook carcasses were sampled. Of wild Chinook, 174 were female (44%) and 218 were male (56% including 47 jacks). Thirty (30) possessed kurl lock tags or opercular punches placed by the crew (11 females, 18 large males, and 1 jack). One (1) of the marked female carcasses possessed an unreadable tag, 1 male carcass had a missing tags (opercular punch only), and 1 tag number on a male carcass was recorded incorrectly (non-viable tag number recorded).

Scale samples were taken from the carcasses of 36 wild females, 10 wild males, 4 CWT females and 5 CWT males in the tag recovery component of the program.

Table 4. *Summary of Chinook handled in 2017 by sex and river reach. Note; 'Tag/Marks Recovered' consists of recovered carcasses at their final destination (not location live tagged).*

Reach	Sex	Tagged/Marked	Hatchery	Dead-Pitched (No tag/mark)	Tag/Marks Recovered	Hatchery Dead-Pitched
Lower	Female	75	15	124	7	10
	Large Male	184	70	108	13	23
	Jack	26	2	27	1	0
Upper	Female	44	5	39	4	5
	Large Male	132	17	45	5	2
	Jack	14	1	19	0	0
Lower + Upper	Total	475	110	362	30	40

Table 3 summarizes Chinook sampled during live tagging and recovery efforts. More males were handled than females during the live tagging and the tag recovery component. The ratio of CWT - wild Chinook handled during live tagging efforts was significantly higher than during tag recovery efforts.

INCIDENTAL CATCH

A total of 6 Chum salmon, 4 Steelhead, 39 Coho salmon, and 1 Sockeye salmon were captured during the tagging program. Pink salmon catches were not recorded and all incidental catches were released immediately to reduce stress caused by handling.

DISCUSSION

During the tagging component of the program in 2017, 110 CWT Chinook were encountered comprising 19% of all live Chinook sampled. Subsampling protocols for CWT recovery may be explored for future programs in the event that the hatchery population is large.

The majority of CWT Chinook are captured in the lower river. Specifically, the section containing the Deep Creek confluence (reach 23) produces a large component of the CWT Chinook return (*Table 1*). It is predictable that CWT Chinook stage below Deep Creek before entering to spawn where they were reared, which illustrates the importance of sampling every reach as evenly as possible to avoid a biased sample. However, high water and recent changes to the river's morphology limited the amount of suitable sampling areas which resulted in higher effort in this reach. Additionally, during the early stages of the tagging program, Chinook tend to hold in deeper pools before occupying spawning redds upon ripening. Few holding pools are suitable for netting, particularly in the lower river, which results in relatively high netting effort in these areas during the early stages (first two weeks) of the program.

Seventy-five (75%) of wild Chinook observed during the tagging portion of the program were male and 25% were female, however, males tend to be more susceptible to gill nets during

the spawning season. It is theorized that males generally do not attempt to avoid gill nets to the same extent as females. The development of a kype, larger mouth and teeth and more angular morphology may contribute to males' susceptibility to gill nets.

Predictably, female Chinook (wild and hatchery) were most commonly observed in the 71-80cm length class, which is likely indicative of age 5_2 or 6_2 (age$_{\text{freshwater years}}$). Scales collected in previous years show that both males and females are most abundant as 6_2 year olds, however, males return younger and older more commonly than females (age 3,4,5, and 7). POH length distributions in *Figure 3* and *Figure 4* seemingly coincide with the historic age structure of females, but males were most abundant in the 51-60cm and 61-70cm length classes.

More males were observed in the tag recovery (dead pitch) component of the program than females in both river reaches. It is more common to dead pitch more females than males, which may be attributed to the males' tendency to stray further from spawning redds before dying (McNicol, 1999), however, this was not observed in 2017.

Scales obtained in the 2017 Kitsumkalum Chinook tagging and recovery program will be used to determine ages of the Kitsumkalum Chinook sampled. Additionally, CWTs recovered during the program will be summarized for estimating exploitation and tag loss rates.

REFERENCES

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APPENDIX A. TAGGING AND RECOVERY PROGRAM STAFF 2016.

- Ian Riemenschneider; *Project Manager*
- Brandon Broderick; *Fisheries/Hatchery Technician*
- Deklan Hodsell; *Fisheries Technician*
- Cameron Thiessen*; Fisheries Technician*

The crew consisted of no more than 4 staff members at one time, and the mark recovery component consisted of 3.

APPENDIX B. BKD RESULTS.

Kitsumkalum Chinook ELISA results			
Case#:	164		
Stock:	Kitsumkalum Chinook		
Fish #	OD reading	result	neg control
31	0.065	N	0.0808518
29	0.066	N	
5	0.068	N	
11	0.068	N	
30	0.068	N	
12	0.068	N	
15	0.069	N	
14	0.070	N	
32	0.071	N	
33	0.071	N	
6	0.074	N	
34	0.074	N	
7	0.075	N	
16	0.075	N	
28	0.075	N	
13	0.076	N	
25	0.076	N	
8	0.077	N	
10	0.078	N	
4	0.078	N	
23	0.079	N	
22	0.080	N	
35	0.080	N	
20	0.082	LLD	
26	0.082	LLD	
24	0.082	LLD	
1	0.082	LLD	
19	0.083	LLD	
9	0.083	LLD	
17	0.085	LLD	
21	0.085	LLD	
2	0.087	LLD	
27	0.090	LLD	
3	0.093	LLD	
18	0.094	LLD	

APPENDIX; C. WATER GAUGE READINGS.

Date	Lower Guage (m)	Upper Guage (m)
14-Aug		1.26
15-Aug	1.32	
16-Aug		
17-Aug		1
18-Aug		
19-Aug		
20-Aug		
21-Aug	1.4	
22-Aug		1.36
23-Aug	1.52	
24-Aug		1.4
25-Aug	1.38	
26-Aug		
27-Aug		
28-Aug	1.76	1.7
29-Aug	1.64	
30-Aug		1.46
31-Aug	1.56	
1-Sep	1.52	1.45
2-Sep	1.5	
3-Sep		
4-Sep		1.09
5-Sep	1.26	
6-Sep		1.06
7-Sep	1.26	
8-Sep		1.08
9-Sep	1.2	
10-Sep		
11-Sep		
12-Sep		
13-Sep		
14-Sep		1.34
15-Sep	1.3	
16-Sep		0.89
17-Sep		
18-Sep	1.02	
19-Sep		0.54
20-Sep	0.9	
21-Sep		0.38
22-Sep	0.82	
23-Sep		0.32
24-Sep		
25-Sep	1.07	
26-Sep		0.86
27-Sep	1.28	
28-Sep		1.12
29-Sep		
30-Sep		
1-Oct		
2-Oct	1.3	
3-Oct		0.84
4-Oct	1.04	
5-Oct		0.52
6-Oct	0.9	