Increased north-migrating Chinook salmon indicator stock coded-wire tagging to improve the quality of Chinook indicator stock analyses

Final Report to the Northern Endowment Fund Committee

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INTRODUCTION

The United States and Canada have recognized the importance of developing and maintaining a coded-wire tag (CWT) program to estimate exploitation rates and better define time-area distributions to develop management options at least since the August 13, 1985 Memorandum of Understanding (PSC 2004: March 2004 Annexes, P. 96). With the 1999 Agreement, CWTs became one of the key methods to assess harvest rate reduction compliance. Furthermore, in the 2009 agreement CWT-based ISBM indices are used to monitor relative exploitation rate reductions from the base period (para. 8(b&c), 9(b&c)). CWT data and analyses are also important for developing stock abundance forecasts used in the Pacific Salmon Commission (PSC) Chinook Technical Committee (CTC) Coastwide model calibration. In 2005, the PSC convened an Expert Panel to review the utility of the CWT system for future Pacific Salmon Treaty (PST) implementation. They reported (Hankin et al. 2005) that the CWT program must be relied upon as the primary fishery and stock assessment tool for at least the next 5-10 years. No alternative technology currently exists that is capable of providing the data necessary for the implementation of the PST. In 2006, the PSC convened a CWT Work Group to review and recommend a plan to implement the recommendations of the PSC Expert Panel. PST Technical Report # 25 states that the principal factors influencing the uncertainty surrounding CWT-based estimates of exploitation rates are those affecting precision and those causing bias. The major factors affecting precision are the number of CWTs released and sample rates for fisheries and escapements. As increased tagging is the most cost effective way to increase precision of CWT-based statistics for these indicator stocks, this project would maintain increased tagging beyond base tagging levels funded by Canadian Department of Fisheries & Oceans (CDFO) to the release group size standards based on expected marine survivals for 2015.

PROJECT OBJECTIVES

The primary and sole objective of this project was to purchase and apply CWTs on Adipose Fin Clipped (AFC) juvenile Chinook salmon incremental to the current tagging levels already funded by CDFO for nine BC Chinook indicator stocks to meet the CWT release group size standards as outlined in PSC Tech. Rep. 25.

METHODS

Adult Chinook salmon are captured upon return to their spawning rivers in the summer or fall. Exact capture methods differ by location, but they include a variety of weir, fish ladder, beach seine, angling and tangle net. Adult Chinook are held at the hatchery, either in concrete ponds or in circular fiberglass tubs (3 m in diameter) until they are ready to be spawned. This determination is made by the fish culturists, who check the females to ensure that the eggs are loose, the belly is soft, and the ovipositor is distended. Eggs are gathered by incising the belly of the female and collecting them in a disinfected

container. Milt is then added from one or two males to fertilize the eggs. Water is then added to the fertilized eggs, after which they are disinfected in a solution of Ovadine and water for 10 minutes. It is at this stage that fish culturists must conduct bulk fecundity sampling to try to ensure that egg targets are met.

Fertilized eggs are placed into the incubation container, which may be a Heath Tray, Atkins cell, or bulk box. Fungal treatments are conducted on eggs, typically using Parasite-S. Chinook eggs typically require approximately 500-525 accumulated thermal units (ATUs) prior to hatching (Billard & Jensen, 1996). Swim up fry are ponded into early rearing containers where they are reared until they are of suitable size for coded wire tagging. Fish health monitoring occurs continuously throughout the early rearing period, with prophylactic and antibiotic treatments used as required. The Salmonid Enhancement Program (SEP) veterinarian is available to diagnose any fish health issues that may arise and works closely with all hatcheries to ensure that fish are healthy prior to marking and release.

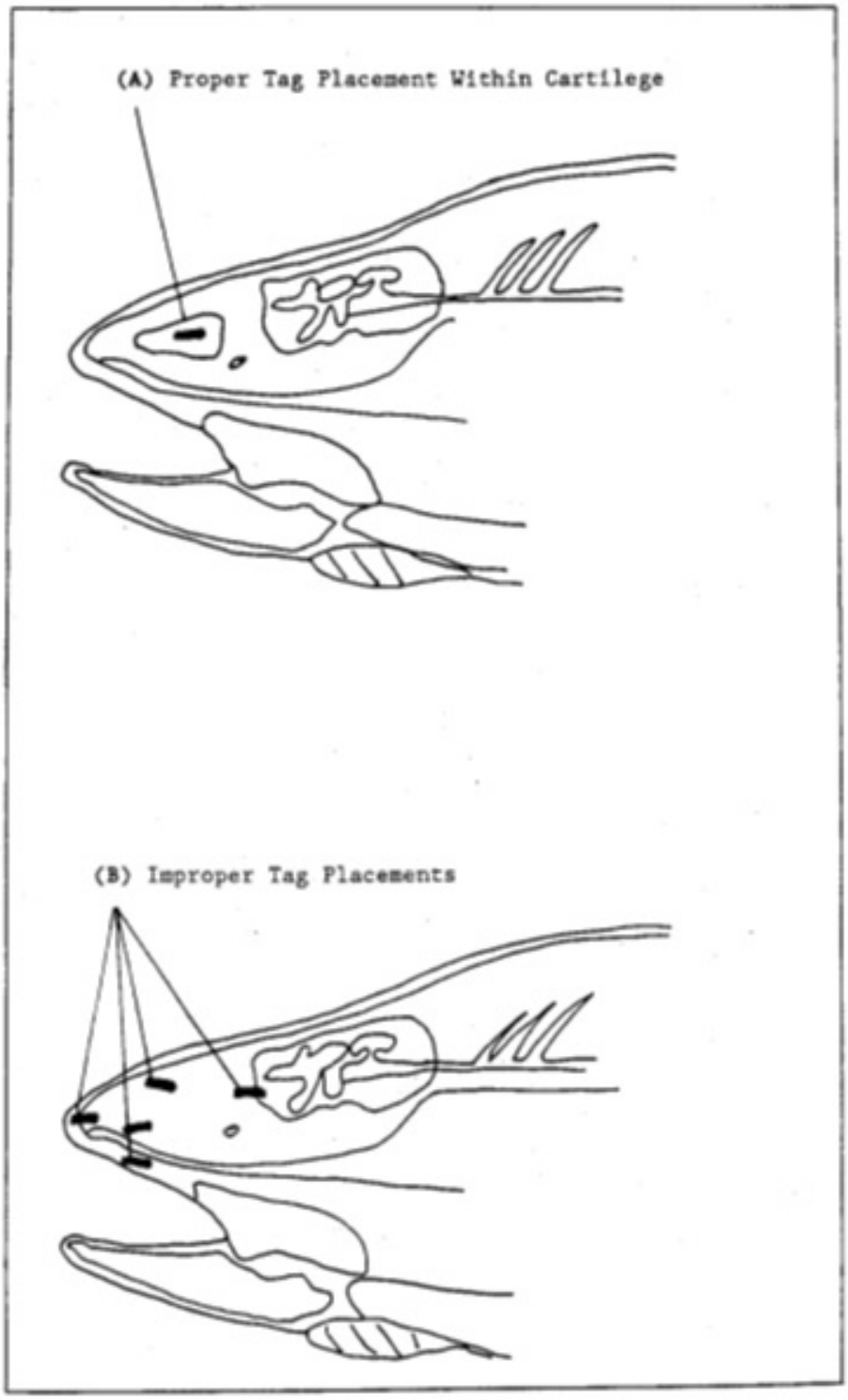
The procedures used to implant the CWTs into juvenile Chinook are documented in detail by Nichols & Hillaby (1990). Marking and tagging of sub-yearling Chinook (fish that have hatched in the spring or winter preceding marking, and that will be released shortly after) occurs when fish begin to reach 3-4 grams (g), with a typical release size of 6 g. Fry must be starved for 48 hours prior to marking and tagging, as this reduces the output of ammonia and excretory by-products associated with stressful fish handling. Juvenile Chinook are transported to the tagging area in small batches into a holding tank prior to being anaesthetized using Tricaine methanesulfonate (TMS). Following anaesthetization, the adipose fin of each juvenile salmon is excised using a set of surgical scissors, after which it is placed nose-first into a Mark IV CWT machine for tag insertion in the nasal tissue. Fish size-grading will occur at fin clipping to ensure that the appropriate sized head mold is used for fish size. Typically, there are 2 or 3 Mark IVs operating simultaneously, often with different sized head molds. Tagged fish are passed through a quality control device (QCD) to ensure successful tag implantation.

Tag placement and retention is monitored in 3 ways. A small group of tagged fish will be retained at the end of each tagging day for a 24 hour retention check the following day. In many instances, small checks will be conducted on a more immediate basis to ensure quality control. In addition to the 24 hour retention check, a larger group of at least 500 fish is kept for up to 30 days to conduct a longer term retention check (Table 2). Finally, to ensure proper tag placement, one tagged smolt is euthanized and dissected every hour, with the tag placement observed (Figure 1).

Detailed operational procedures may vary slightly by facility, but generally follow the practices as described by Nichols & Hillaby (1990).

Following tag application, juvenile Chinook are released from the hatchery back into their river of origin after a short period of holding (~2 week). Hatcheries that have swim-in infrastructure will release directly from the hatchery to the river, while stocks from hatcheries without this mechanism will be transported to the river and force released. Juvenile releases typically occur when Chinook are smolting, although some juveniles may stay in the river for a short period of time prior to migrating to saltwater.

Figure 1 - Proper coded wire tag placement (Nichols & Hillaby, 1990)



RESULTS

Coded wire tagging began on schedule at all sites, as water temperatures during the incubation and rearing period were relatively normal. All tagging project operations were completed at or before the expected date, and there were no significant fish health issues during the tagging process.

Table 1 - Tag application schedule by hatchery.

Hatchery	Stock	Tagging Period
Chilliwack	Chilliwack	April - May
Cowichan	Cowichan	March - April
Deep Creek	Kitsumkalum	May - June
Harrison	Harrison	April - May
Quinsam	Quinsam	March – April
Robertson	Robertson	April - May
Shuswap	Lower Shuswap	April – May
Snootli	Atnarko	May – June
Spius	Nicola	Sept - Oct

Table 2 - Estimated tag loss rate by hatchery / stock during 2015 tag application.

Hatchery	Stock	Tag Loss
Chilliwack	Chilliwack	2.08%
Cowichan	Cowichan	0.33%
Deep Creek	Kitsumkalum	0.24%
Harrison	Harrison	0.00%
Quinsam	Quinsam	0.72%
Robertson	Robertson	0.46%
Shuswap	Lower Shuswap	5.14%
Snootli	Atnarko	0.60%
Spius	Nicola	1.54%

Table 3 – Tag targets and actuals (base level and incremental) for the 2015 tag application.

Stock	Base Level CWT Target	Additional CWT Target	Total CWT Target	Total CWT Applied in 2015
Atnarko	150,000	250,000	400,000	405,431
Chilliwack	100,000	100,000	200,000	313,436
Cowichan	200,000	400,000	600,000	813,923
Harrison	100,000	200,000	300,000	291,658
Kitsumkalum	60,000	200,000	260,000	171,337
Lower Shuswap	250,000	300,000	550,000	440,378
Nicola	140,000	60,000	200,000	172,732
Quinsam	200,000	300,000	500,000	657,568
Robertson	200,000	250,000	450,000	521,253
Total	**1,400,000**	**2,060,000**	**3,460,000**	**3,668,038**

Table 4 - Base tagging level and percentage increase due to expanded tagging, by brood year and stock.

Stock	Base Tag Level	2009	2010	2011	2012	2013	2014
Atnarko R Low	150,000	246%	239%	194%	166%	163%	170%
Chilliwack R	100,000	90%	98%	96%	100%	212%	213%
Cowichan R	200,000	110%	119%	175%	199%	12%	307%
Harrison R	100,000	113%	95%	176%	190%	172%	192%
Kitsumkalum	60,000	344%	354%	249%	113%	175%	186%
Nicola R	140,000	38%	34%	52%	36%	24%	23%
Quinsam R	200,000	227%	217%	185%	224%	200%	229%
Robertson Cr	200,000	126%	124%	122%	126%	139%	161%
Shuswap R Low	250,000	93%	96%	101%	104%	85%	76%

Table 5 - Total observed fishery CWTs, by brood year and stock.[1]

Stock	2009	2010	2011	2012	2013
Atnarko	687	694	541	58	1
Chilliwack	396	1283	810	172	3
Cowichan	292	415	390	55	1
Harrison	76	256	196	10	3
Kitsumkalum	53	210	92	4	1
Lower Shuswap	326	1172	431	96	0
Nicola	48	9	36	1	0
Quinsam	88	60	78	93	6
Robertson	56	323	56	273	7

[1]Updated from MRP database - March 2016.

Table 6 - Total observed fishery CWTs directly attributable to PSC funded expanded tagging, by brood year and stock.

Stock	2009	2010	2011	2012	2013
Atnarko	488	489	357	36	1
Chilliwack	187	635	397	86	2
Cowichan	153	225	248	37	0
Harrison	40	125	125	7	2
Kitsumkalum	41	164	66	2	1
Lower Shuswap	90	298	148	26	0
Nicola	33	6	23	1	0
Quinsam	49	33	43	52	3
Robertson	27	158	28	139	3

DISCUSSION

Actual tag application numbers exceeded targets on 5 of 9 stocks, with 4 of the 9 stocks coming in a little under target. The total project overall goal of 3.6 million CWTs applied was exceeded. It is common to apply up to 10% more tags than planned, as the spools of wire that the tags are printed on can be run out right to the end, which allows some extra tags to be applied. Increases in tagging numbers help to increase the number of observed and estimated CWTs, which will result in increased precision in estimated of survival and exploitation rate.

Actual tag application numbers are subject to variability for several reasons, including but not limited to insufficient broodstock available for egg target, lower than expected in-hatchery survival, or unresolvable tagging equipment malfunctions. Hatcheries that have large production targets to support fisheries will very rarely fail to reach their tag target. For example, Robertson Creek hatchery has a production target of 6M smolts, of which only 450K are required for tagging (base level + incremental). Thus, even with a very weak adult return and a fraction of their egg target, the tagging target can still be met. Conversely, stocks that are enhanced purely for stock assessment purposes (Lower Shuswap and Kitsumkalum) have less flexibility in their targets. If there are surplus juveniles available they will typically all be tagged, however if there is any issue obtaining the release target (such as at Kitsumkalum in 2014) the tag target will be compromised.

The Kitsumkalum tag target is unique in that it is comprised of two different year classes; fed fry that are tagged and released the spring following emergence, and yearling smolts that are tagged at the same time as fed fry but that are held for an additional year prior to release. Water flow interruption to one of the rearing containers caused some juvenile loss. This was attributed likely to water flow not being re-started adequately after screens had been cleaned.

Although the direct results of the tagging completed in 2015 (2014 brood) will not be apparent until those fish begin to recruit to the fishery and escapement as jacks in 2016, it can be assumed with certainty that the number of observed tags in catch and escapement will have increased as a function of the increase in tagging over the base level. Incremental tagging has been occurring at sites since 2009, with some sites starting earlier. This work has been previously funded through the Coded Wire Tag Improvement Fund of the PSC, and the results of this earlier work can be used to illustrate the future benefits of this 2015 NEF project. Note that at the time of this report, brood years 2009-2013 are considered preliminary as there are still cohorts that will likely recruit to catch and escapement in upcoming years. Table 5 shows the total observed fishery tags, by brood year and stock (data current as of March 2016), while Table 6 shows the observed tags that are directly attributable to the expanded tagging projects. It is important to note that only the 2009 brood can be considered a complete brood year, with the rare exception of the return of any 7 year old adults.

It is too early to be able to assess the ultimate success of this project, as well as those that preceded it. This project represents the first step in a complex process that requires fishery and escapement sampling to recover CWTs. Even upon completion of the 2015 spawning and catch year, there are still cohorts that have yet to return from the majority of the years of expanded tagging.

APPENDIX 1

Financial Expenditure Summary

Details of expenditures registered in the DFO financial system at fiscal year-end.

PACIFIC SALMON COMMISSION (PSC)

Project Code 57770 2015-2016 Expenditures

Contractor Costs

Hatchery / Facility	Contractor	Cost
Snootli	CCFPA	$ 22,500
Cowichan	Gailforce	$ 47,019
Harrison	T'sailes FN	$ 16,000
Nicola	EH-Fish	$ 5,160
Robertson	Shir-shot	$ 25,725
Shuswap, Lower	EH-fish	$ 21,500
Kitsumkalum	Terrace SES	$ 26,250
		$ 164,154

Salary Costs

Hatchery / Facility	Description	Cost
Chilliwack	salary	$ 5,200
Quinsam	salary	$ 5,618
		$ 10,818

Equipment & Gear Costs

Vendor	Item(s)	Cost
Keir Surgical	Fin Clipping Scissors	$ 33,982
NMT	Tagging machine parts	$ 22,629
ISL	Brokerage fees (NMT order)	$ 1,303
Syndel	Anesthetic	$ 739
Head Lab	CWT Head Labels	$ 3,780
		$ 62,434

Total Expenditures	**$ 237,405**
Total Funds received from PSC	**$ 260,647**
Balance	**$ 23,242**
Refunded to the PSC	**$ 23,242**

REFERENCES

Nichols, T.L., and J.E. HIllaby. 1990. Manual for Coded-Wire Tagging and Fin Clipping of Juvenile Salmon at Enhancement Operations Facilities. Prepared under contract #90SB.FP501-7-0060/A to Supply and Services Canada by Streamline Consulting Services Limited

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