

McLoughlin Creek Enhanced Chum Assessment Project Year 6 of 6

Final Report to the Pacific Salmon Commission's Northern Endowment Fund Committee

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Table of Contents

Introduction	3
Project Objectives	3
Methods	3
Brood Collection	3
Juvenile Chum Marking	3
Escapement Sampling.....	4
Area 7 Sampling:.....	4
Results	4
Juvenile Chum Marking	4
Adult Assessment of Area 7 Chum Fishery.....	5
2014- Assessment of Area 7 Fishery	5
2015 - Assessment of Area 7 Fishery	6
2016 - Assessment of Area 7 Fishery	7
2017- Assessment of Area 7 Fishery	9
Adult Assessment – of Escapement.....	9
2014 - Assessment of McLoughlin Creek Escapement.....	9
2015 - Assessment of McLoughlin Creek Escapement.....	10
2016 - Assessment of McLoughlin Creek Escapement.....	11
2017- Assessment of McLoughlin Creek Escapement.....	12
Contribution to Area 7 Fisheries and Survival Rates	13
Discussion.....	14
Age Composition	14
Enhanced Contribution.....	14
Survival Rate	15
APPENDIX I - 2017 Financial Expenditures Summary	16

Introduction

Chum production from the Heiltsuk Community Economic Development Project Hatchery in Bella Bella, B.C. has consistently supported a commercial fishery and a food, social and ceremony (FSC) harvest. Starting in brood year 2008, production of McLoughlin Bay chum was doubled to 2 million fry releases. Returns in subsequent years suggested outer coast chum may be surviving at a higher rate than inner coast chum stocks. Through a low cost fin clipping program, this project aims to estimate the enhanced contribution of this stock to catch and escapement, as well as determine survival rates for marked brood years. This data will inform hatchery production as well as fishery management decisions for both inner and outer central coast chum stocks. Years 1 and 2 of this project consisted solely of juvenile salmon marking; year 3 consisted of marking as well as low-cost escapement and fishery sampling. Year 4 to 6 consisted entirely of escapement and fishery sampling. 2017 was the final year of the assessment program.

Project Objectives

This project proposes to directly assess the survival rates of an enhanced outer central coast chum stock. The Canadian Department of Fisheries and Oceans (CDFO) currently has a long term data set of chum survival rates from an inner central coast stock (Bella Coola River), but escapements in recent years have indicated a different survival rate between these two areas. By marking a known number of McLoughlin Creek fed chum fry each spring from the 2011-2013 brood years, returns can be assessed for total abundance (catch + escapement) and examined for mark incidence. Estimates of mark incidence by age class and sampling stratum are used to calculate a total marked return for each brood year, which allows for an estimate of survival rate, with an associated uncertainty value (CV<15%). With an accurate estimate of survival rate, an estimate of enhanced contribution to harvest was also calculated.

Methods

Brood Collection

Culture of brood collected by Heiltsuk Hatchery begins with egg takes in McLoughlin Creek between September and October. Primary incubation (to eyed stage) is done in Atkins bulk incubators and secondary incubation occurs in Kitoi style bulk incubators (these were installed with PSC northern funds in 2008 NF-2008-E-4) and Keeper Box style incubators. At the swim-up stage fry are ponded to rearing troughs at the hatchery and held for a few days to initiate feed. Once feeding begins, fry are transferred to salt water netpens for final rearing. Rearing in the netpens continued for all fry until a 1.0 gram average weight is attained. In 2011 to 2013 approximately 160,000 fry were kept back at the hatchery and used to accomplish the marking project.

Juvenile Chum Marking

Juvenile chum marking occurred from 2011-2013. Visual marking was accomplished by removing the adipose fin using microsurgical iris scissors. Fry were processed through a marking table specially designed and outfitted for this purpose. Small net loads of unmarked fry were anesthetized and then

placed in net “baskets”. The docile fry were then picked up, and with the aid of a magnifying light, the scissor blades were placed in line with the back of the fish snug up against the adipose fin and closed. Marked fry were placed in a short term recovery net by the marker and moved to larger recovery bucket as the net filled. A hand tally counter was set up by each basket so crew could record each fish that was clipped. Marked fish were checked for clip quality on a regular basis and mortalities at the table or in the rearing trough were recorded.

Escapement Sampling

Escapement sampling in McLoughlin Creek occurred from 2014-2017. In the late summer and early fall the escapement was sampled for mark rate, as well as for age composition. All adults removed from the creek for broodstock were examined for marks and records were kept of unmarked and marked adults by sex. These fish were not introduced back into the creek so would not be examined twice. The small size of the spawning creek and limited distribution of chum spawners allowed for stream walks and use of a carcass weir by hatchery staff for the sampling of adult spawners in the escapement. Adults that died in the creek, either pre-spawn or post-spawn were examined for marks and cut in two as part of the dead-pitch program. Information was recorded and used to obtain a mark rate of the escapement and to estimate the total escapement to the river. Scale samples for ageing were collected from both marked and unmarked adults.

Area 7 Sampling:

From 2014-2017 JO Thomas and Associates Ltd. was contracted to provide sampling of commercial seine and gillnet fisheries in areas where they were likely to intercept McLoughlin chum. McLoughlin chum are targeted in near-terminal fisheries in Area 7. Sampling of catch from Area 7 chum fisheries targeted a 20% sampling rate to calculate a precise mark rate estimate. Sampling included mark incidence by sex, as well as scale sampling for age distribution.

Results

Juvenile Chum Marking

Brood years 2011 to 2013 were marked. The project had a target of marking 160,000 fed fry for three years, and met this target in 2011 and 2013 (Table 1).

Table 1 - McLoughlin Creek brood releases and mark rate by brood year

	2011	2012	2013
Seapen Release (Unmarked)	1,911,520	1,707,284	1,632,860
Hatchery Release (Marked)	161,622	146,657	168,786
Total Release	2,073,142	1,853,941	1,801,646
Mark Rate	7.80%	7.91%	9.37%

Adult Assessment of Area 7 Chum Fishery

2014- Assessment of Area 7 Fishery

2014 was the first year with expected returns of 2011 brood year release marked chum from McLoughlin Creek. JO Thomas was contracted to provide sampling of commercial seine and gillnet fisheries in Area 7 that were likely to intercept McLoughlin chum. A total of 163,469 chum were recorded as catch in the fishery which spanned statistical weeks 084 through 092 (Table 2). Of that catch, a total of 29,783 chum were sampled for marks and 71 were found to be Ad-clipped. To determine age composition of the catch, scales were sampled from all marked chum as well as 550 unmarked chum. Of these, 534 returned usable age data (Table 3). Fourteen four-year-old marked fish were recorded in the sampled fishery. Since brood year 2010 was not marked, these fish scales were either misread and are actually three-year-olds, or they are Snootli Hatchery origin chum, which would imply a portion of the fishery was mixed with Area 8.

Table 2 - 2014 Area 7 commercial chum fishery total catch and sample rate.

Statistical Week	Area	Gear	Catch	Sample Size	Sample Rate
84	7	Seine	30,224	5,000	16.54%
		Gillnet	11,218	-	0.00%
		Total	41,442	5,000	12.07%
091	7	Seine	62,603	16,169	25.83%
		Gillnet	14,110	-	0.00%
		Total	76,713	16,169	21.08%
092	8	Seine	29,600	6,065	20.49%
		Gillnet	15,714	2,549	16.22%
		Total	45,314	8,614	19.01%
084 - 092	7	Seine	122,427	27,234	22.25%
		Gillnet	41,042	2,549	6.21%
		Total	163,469	29,783	18.22%

Table 3 - 2014 Area 7 commercial chum fishery age composition

Species	Gilbert-Rich	Brood Yr.	Marked	Percent Marked	Unmarked	Percent Unmarked
Chum	51	2009	0	0%	12	2%
	41	2010	14	21%	387	72%
	31	2011	54	79%	135	25%
Total			68	100%	534	100%

Based on age distribution and mark rate, the total enhanced contribution to the Area 7 fishery from brood year 2011 was approximately 0.8% in 2014 (Table 4). This translates to 1381 hatchery-origin chum. The dominant age of return was age 4 (72%), but since this brood year was not marked, we cannot calculate the enhanced contribution to 4-year-old catch.

Table 4 - Summary of contribution to the 2014 Area 7 commercial chum fishery from McLoughlin Creek chum enhancement of brood year (BY) 2011.

2014	Age 3 (BY2011)
Catch percentage by age	25%
Total catch by age	40,867
Estimated catch marked	108
Catch mark rate	0.36%
Catch enhanced (expanded)	1,381
Enhanced contribution to catch	0.8%

The hatchery reported an estimate of 1,250 for FN FSC fisheries. No sampling occurred on this catch and the catch data is not incorporated into this report.

2015 - Assessment of Area 7 Fishery

2015 was the second year with expected returns of marked chum; these being from the 2011 and 2012 brood year releases. JO Thomas was contracted to provide sampling of commercial seine and gillnet fisheries in Area 7 that were likely to intercept McLoughlin chum. A total of 248,919 chum were recorded as catch in the fishery which spanned statistical weeks 075 through 093 (Table 5). Of the total catch, 55,325 chum were sampled for marks and 608 were found to be marked, for an overall mark rate for 1.1%. A total of 763 fish were sampled and processed for age (Table 6).

Table 5 - 2015 Area 7 commercial chum fishery total catch and sample rate.

Statistical Week	Area	Gear	Catch	Sample Size	Sample Rate
075	7	Seine	162	-	0.00%
		Gill Net	-	-	0.00%
		Total	162	-	0.00%
081	7	Seine	2,800	-	0.00%
		Gill Net	682	-	0.00%
		Total	3,482	-	0.00%
082	8 (Area 7 fishery)	Seine	20,153	1,149	5.70%
		Gill Net	1,920	-	0.00%
		Total	22,073	-	0.00%
083	7	Seine	83,437	14,652	17.56%
		Gill Net	16,460	1,854	11.26%
		Total	99,897	17,655	17.67%
091	7	Seine	95,764	25,589	26.72%
		Gill Net	53,258	12,081	22.68%
		Total	149,022	37,670	25.28%
092	7	Seine	10,540	-	0.00%

Statistical Week	Area	Gear	Catch	Sample Size	Sample Rate
		Gill Net	15,233	-	0.00%
		Total	25,773	-	0.00%
093	7	Seine	6,899	-	0.00%
		Gill Net	3,239	-	0.00%
		Total	10,138	-	0.00%
075 - 093	7	Seine	179,201	41,390	23.10%
		Gill Net	69,718	13,935	19.99%
		Total	248,919	55,325	22.23%

Table 6 - 2015 Area 7 commercial chum fishery age composition

Species	Gilbert-Rich	Brood Yr.	Marked	Percent Marked	Unmarked	Percent Unmarked
Chum	31	2012	26	5.27%	30	11.11%
	41	2011	464	94.12%	231	85.56%
	51	2010	3	0.61%	9	3.33%
		Total	493	100%	270	100%

Based on age distribution and mark rate, the total enhanced contribution to the Area 7 fishery from brood year 2011 and 2012 was estimated to be approximately 13.9% in 2015 (Table 4). This translates to 34,522 hatchery-origin chum. The dominant age of return was age 4 (91%).

Table 7 - Summary of contribution to the 2015 Area 7 commercial fishery from McLoughlin Creek chum enhancement of brood years (BY) 2011 and 2012.

2015	Age 3 (BY 2012)	Age 4 (BY2011)	Total
Catch percentage by age	7.34%	91.09%	98.43%
Total catch by age	18,271	226,740	245,011
Estimated catch marked	201	2,494	2,695
Catch mark rate	0.08%	1.00%	1.08%
Catch enhanced (expanded)	2,530	31,993	34,522
Catch enhanced contribution	1.02%	12.85%	13.87%

The hatchery reported an estimate of 1,000 for FN FSC fisheries. No sampling occurred on this catch and the catch data is not incorporated into this report.

2016 - Assessment of Area 7 Fishery

2016 was the third year with expected returns of marked chum; these being from the 2011-2013 brood year releases. A total of 62,105 chum were caught in the 2016 Area 7 fishery, which spanned statistical weeks 075 through 093 (Table 8). Of the total catch, 6,957 were sampled for marks during weeks 91 – 93 and 61 chum were found to be adipose clipped, indicating a mark rate of 0.88%. A total of 240 fish were sampled and processed for age, of which 234 were successfully read (Table 9).

Table 8 - 2016 Area 7 commercial chum fishery total catch and sample data.

Statistical Week	Area	Gear	Catch	Sample Size	Sample Rate
075	7	Seine	-	-	0.00%
		Gill Net	2,358	-	0.00%
		Total	2,358	-	0.00%
081	7	Seine	2,216	-	0.00%
		Gill Net	5,912	-	0.00%
		Total	8,128	-	0.00%
082	8 (Area 7 fishery)	Seine	4,749	-	0.00%
		Gill Net	3,128	-	0.00%
		Total	7,877	-	0.00%
091	7	Seine	15,418	1,463	9.49%
		Gill Net	15,196	3,441	22.64%
		Total	30,614	4,904	16.02%
093	7	Seine	-	-	0.00%
		Gill Net	13,128	2,053	15.64%
		Total	13,128	2,053	15.64%
Total	7	Seine	22,383	1,463	6.54%
		Gill Net	39,722	5,494	13.83%
		Total	62,105	6,957	11.20%

Table 9 - 2016 Area 7 commercial chum fishery age compositions

Species	Gilbert-Rich	Brood Yr.	Marked	Percent Marked	Unmarked	Percent Unmarked
Chum	31	2013	24	60.00%	73	37.63%
	41	2012	12	30.00%	105	52.12%
	51	2011	4	10.00%	16	8.24%
Total			40	100%	194	100%

Based on age distribution and mark rate, the total enhanced contribution to the Area 7 fishery was approximately 10% in 2016 (Table 10). This translates to 6477 hatchery-origin chum. The dominant age of return was age 4 (50%), followed closely by age 3 (41%).

Table 10 - Summary of contribution to the 2016 Area 7 commercial chum fishery from McLoughlin Creek chum enhancement of brood years (BY) 2011-2013.

2016	Age 3 (BY 2013)	Age 4 (BY2012)	Age 5 (BY 2011)	Total
Catch percentage by age	41.45%	50.00%	8.55%	100%
Total catch by age	25,743	31,053	5310	62,105
Estimated catch marked	227	273	47	547
Catch mark rate	0.37%	0.44%	0.080%	0.88%
Catch enhanced (expanded)	2423	3451	603	6477
Catch enhanced contribution	3.9%	5.56%	0.97%	10.43%

The hatchery reported a harvest estimate of 1,000 chum for FN FSC fisheries. No sampling occurred in this catch and the catch data is not incorporated into this report.

2017- Assessment of Area 7 Fishery

In 2017 gill nets and seine fisheries opened in Area 7 on July 31 and August 7. Catch for seine was zero chum, catch for gill net was 3,138 chum, all of which were identified as mixed with Area 8 chum before landing. Area 8 chum could include marked chum from Snootli hatchery. Consequently, we were unable to assess the contribution of McLoughlin chum to the Area 7 commercial fishery in 2017.

The hatchery reported a harvest estimate of 500 chum for FN FSC fisheries. No sampling occurred in this catch and the catch data is not incorporated into this report.

Adult Assessment – of Escapement

2014 - Assessment of McLoughlin Creek Escapement

In 2014 a total of 2,126 adults were examined for marks during broodstock collection and 3,398 adults were examined for marks during dead-pitch (Table 11). A total mark rate of 0.8% was estimated for the escapement: 0.95% in broodstock, and 0.67% in the deadpitch. During sampling, 119 scale samples were collected from a mix of male, female, marked and unmarked chum and processed to generate a profile of age class composition (Table 12). The dominant age at return was age 4.

Table 11 – 2014 McLoughlin Creek chum river return.

Source	Males Unmarked	Males Marked	Females Unmarked	Females Marked	Unknown Sex & Mark	Grand Total
Broodstock	1,012	16	1,094	4	0	2,126
Deadpitch	1,664	15	1,612	7	100	3,398
Other	0	0	0	0	850	850
Total	2,676	31	2,706	11	950	6,374

Table 12 – 2014 McLoughlin Creek chum river return age composition.

Species	Gilbert-Rich	Brood Year	Frequency	Percent
Chum	51	2009	8	6.70%
	41	2010	85	71.40%
	31	2011	26	21.80%
Total			119	100.00%

Based on age distribution and mark rate, the total enhanced contribution to the 2014 escapement was approximately 2.2% (Table 13). This translates to 141 hatchery-origin chum. The dominant age of return was age 4 (~71%).

Table 13 - Summary of contribution to the 2014 McLoughlin Creek chum escapement by enhancement of brood year (BY) 2011.

2013	Age 3 (BY 2011)
Escapement composition by age	21.8%
Escapement breakdown by age	1390
Escapement marked	11
Escapement mark rate	0.17%
Escapement enhanced (expanded)	141
Enhanced contribution to escapement	2.2%

2015 - Assessment of McLoughlin Creek Escapement

In 2015 a total of 2,145 adults were examined for marks during broodstock collection and 2,988 during dead-pitch (Table 14). A total mark rate of 8.1% was estimated for the escapement: 7.8% in broodstock, and 8.4% in the deadpitch. During dead-pitch, 150 scale samples were collected from a mix of male, female, marked and unmarked chum, and then processed to generate a profile of age class composition (Table 15). The dominant age at return was age 4 (~90%).

Table 14 – 2015 McLoughlin Creek chum escapement mark samples.

Source	Males Unmarked	Males Marked	Females Unmarked	Females Marked	Unknown Sex & Mark	Grand Total
Broodstock	959	78	1019	89	0	2145
Deadpitch	1441	113	1032	114	288	2988
Total	2400	191	2051	203	288	5133

Table 15 – 2015 McLoughlin Creek chum river return age composition.

Species	Gilbert-Rich	Brood Year	Unmarked	Percent Unmarked	Marked	Percent Marked
Chum	31	2012	8	15%	0	0%
	41	2011	42	78%	76	100%
	51	2010	4	7%	0	0%
Total			54	100%	76	100%

Based on age distribution and mark rate, the total enhanced contribution to the 2015 escapement was approximately 101% (Table 16). This translates to 6,622 hatchery-origin chum. There cannot be more than 100% enhanced return to the escapement. This excessive value is an artifact of the mark-rate expansion, and indicates the vast majority of returns were hatchery origin.

Table 16 – Summary of contribution to the 2015 McLoughlin Creek chum escapement by enhancement of brood years(BY) 2011 and 2012.

2015	Age 3 (BY 2012)	Age 4 (BY2011)	Total
Escapement composition by age	6.2%	90.8%	97%
Escapement breakdown by age	403	5,955	6358
Escapement marked	33	484	517
Escapement mark rate	0.50%	7.38%	7.88%
Escapement enhanced (expanded)	413	6,210	6,622
Enhanced contribution to escapement	6.29%	94.66%	101%

2016 - Assessment of McLoughlin Creek Escapement

A total of 2,015 adults were examined for marks during broodstock collection and 7,748 during dead-pitch in 2016 (Table 17). A total mark rate of 5.4% was estimated for the escapement: 9.1% in broodstock, and 4.4% in the deadpitch. During dead-pitch, 150 scale samples were collected from a mix of male, female, marked and unmarked chum. These were processed to generate a profile of age class composition (Table 18). The dominant age at return was age 3 (~ 75%).

Table 17 – 2016 McLoughlin Creek chum escapement mark samples.

Source	Males Unmarked	Males Marked	Females Unmarked	Females Marked	Unknown Sex & Mark	Grand Total
Broodstock	917	90	914	94	0	2015
Deadpitch	3800	193	3609	146	0	7748
Total	4717	283	4523	240	0	9763

Table 18 – 2016 McLoughlin Creek chum river return age composition in deadpitch.

Species	Gilbert-Rich	Brood Year	Unmarked	Percent Unmarked	Marked	Percent Marked
Chum	21	2014	1	1%	0	0%
	31	2013	53	78%	59	72.8%
	41	2012	14	21%	17	21.0%
	51	2011	0	0%	5	6.2%
Total			68	100%	81	100%

Based on age distribution and mark rate, the total enhanced contribution to the 2016 escapement was approximately 47% (Table 19). This translates to 4,587 hatchery-origin chum. The dominant age of return was age 3 (~75%).

Table 19 – Summary of contribution to the 2016 McLoughlin Creek chum escapement by enhancement of brood years (BY) 2011, 2012 and 2013.

2016	Age 3 (BY 2013)	Age 4 (BY2012)	Age 5 (BY 2011)	Total
Escapement composition by age	75.2%	20.8%	3.4%	100%
Escapement breakdown by age	7,342	2031	332	9736
Escapement marked	394	109	18	521
Escapement mark rate	4.0%	1.1%	0.2%	5.3%
Escapement enhanced (expanded)	2,978	1378	231	4,587
Enhanced contribution to escapement	30.5%	14.1%	2.4%	47.0%

2017- Assessment of McLoughlin Creek Escapement

In 2017 a total of 1937 adults were examined for marks during broodstock collection and 3829 during dead-pitch (Table 20). A total mark rate of 4.9% was estimated for the escapement: 5.9 % in the broodstock, and 4.5% in the deadpitch. During brood collection, 135 scale samples were collected from a mix of male, female, marked and unmarked chum. These were processed to generate a profile of age class composition (Table 21). 15 scales from the deadpitch were also collected from a mix of males and females, though only 2 of which were unmarked.

Table 20 - 2017 McLoughlin Creek chum escapement mark samples.

Source	Males Unmarked	Males Marked	Females Unmarked	Females Marked	Unknown Sex or Mark	Grand Total
Broodstock	873	45	893	59	67	1937
Deadpitch	1819	79	1834	75	22	3829
Total	2692	124	2727	134	89	5766

Table 21– 2017 McLoughlin Creek chum river return age composition in escapement

Species	Gilbert-Rich	Brood Year	Unmarked	Percent Unmarked	Marked	Percent Marked
Chum	31	2014	9	10.0%	1	1.7%
	41	2013	80	88.9%	57	95.0%
	51	2012	1	1.1%	2	3.3%
Total			90	100%	60	100%

Based on age distribution and mark rate, the total enhanced contribution to the 2017 escapement was approximately 45.5% (Table 22). This translates to 2622 hatchery-origin chum. The dominant age of return was age 4 (~90%).

Table 22 - Summary of contribution to the 2017 McLoughlin Creek chum escapement by enhancement of brood years 2012 and 2013.

2017	Age 4 (BY2013)	Age 5 (BY 2012)	Total
Escapement composition by age	91.33%	2.0%	93.33%
Escapement breakdown by age	5266	115	5381
Escapement marked	239	5	244
Escapement mark rate	4.1%	0.09%	4.8%
Escapement enhanced (expanded)	2558.9	63	2622
Enhanced contribution to escapement	44.4%	1.1%	45.5%

Contribution to Area 7 Fisheries and Survival Rates

The total hatchery contribution from each brood year to the fishery and to escapement is summarized in

A potential source of error when calculating survival rates was identified during data analysis. Only 3 brood years of chum were marked; therefore, samples in 2014, 2015 and 2017 would include adult returns from unmarked brood years. In each of these years marked scale sample results came back associated with unmarked brood years (e.g. in 2014 escapement 21% of marked fish were determined to be 4-years-olds, when only the 3-year-old returns would be marked). Errors such as these could occur for a variety of reasons including: natural fin loss, misidentification of fin status, errors in scale ageing, or strays from Snootli Creek. Since we could not identify the source of the error, we removed these samples from our analysis.

Table 23 and

Table 24, respectively. These overall hatchery-origin returns are used to determine survival rates (*incomplete

Table 25). Because the 2017 Area 7 fishery was not sampled, the survival rates from 2012 and 2013 are incomplete. Since brood year 2012 has the two dominant age class returns (age 3 and 4), we were able to calculate a survival rate that is considered an underestimate. However, for brood year 2013 there is only one full year of return data, and any survival rate values are considered incomplete.

A potential source of error when calculating survival rates was identified during data analysis. Only 3 brood years of chum were marked; therefore, samples in 2014, 2015 and 2017 would include adult returns from unmarked brood years. In each of these years marked scale sample results came back associated with unmarked brood years (e.g. in 2014 escapement 21% of marked fish were determined to be 4-years-olds, when only the 3-year-old returns would be marked). Errors such as these could occur for a variety of reasons including: natural fin loss, misidentification of fin status, errors in scale ageing, or strays from Snootli Creek. Since we could not identify the source of the error, we removed these samples from our analysis.

Table 23 – Estimated enhanced contribution to Area 7 chum fishery by recovery and brood year. No Area 7 fishery sampling occurred in 2017.

	2011 Brood Year	2012 Brood Year	2013 Brood Year
2014 Fishery	1,381		
2015 Fishery	31,993	2,530	
2016 Fishery	603	3,451	2,423
2017 Fishery		-	-
Total	33,977	5,981*	2,423*

*incomplete

Table 24 - Estimated enhanced contribution to McLoughlin Creek escapement.

	2011 Brood Year	2012 Brood Year	2013 Brood Year
2014 Escapement	141		
2015 Escapement	6,210	413	
2016 Escapement	231	1,378	2,978
2017 Escapement		63	2,559
Total	6,582	1,854	5,537*

*incomplete

Table 25 -Survival rate, including catch, for each brood year. Note 2012 and 2013 are incomplete as the fishery was not sampled in 2017.

Brood Year	Survival Rate (Including Catch)	Comments
2011	1.96%	
2012	0.42%	Does not include 5-year-old-commercial catch
2013	0.44%	Does not include 4- and 5 year-old commercial catch

Discussion

Age Composition

The Area 7 commercial fishery was sampled in 2014, 2015 and 2016, but was not sampled successfully in 2017. In 2017 JO Thomas attempted to sample the Area 7 gill net and seine fisheries when they opened on July 31 and August 7. Catch for seine fisheries was zero chum, catch for gill net fisheries was 3,138 chum, all of which were identified as mixed with Area 8 chum before landing. Area 8 chum could include marked chum from Snootli hatchery. Consequently, we were not able to determine the age distribution in the catch for this cycle. The dominant age of chum caught in the fishery was age 4, except in 2016 when it was 50% age 3. That strong 3-year-old return in the 2016 commercial catch was not reflected in neighbouring fisheries. The Area 8 chum fishery (to the south) was dominated (~70%) by 4-year-olds in this same year, indicating that it was not a coast-wide phenomenon.

Complete estimates of enhanced contribution to escapement are available for the 2011 and 2012 brood years, as all cohorts have returned to spawn in McLoughlin Creek. Scale age data indicates this

population was comprised predominantly of 4-year-old adults; which is a trend that was also observed at Snootli Creek Hatchery. However, much like the fishery, in 2016 3-year-old hatchery-origin chum dominated the escapement to McLoughlin Creek.

Enhanced Contribution

The target fishery sampling rate of 20% was only met in one of the four years that sampling occurred, and ranged from 0 to 22%. Because no samples were collected in 2017, we were unable to determine enhanced contribution to the fishery for that year. The enhanced contribution to fishery was 1%, 13% and 11% for 2014, 2015 and 2016 respectively. However, these values are likely underestimated for 2014 and 2015 because it is based on marked returns, and not all returning brood years were marked.

In 2014, 2015, and 2016, a greater proportion of hatchery-origin chum were observed in the escapement, compared to the fishery. Escapement sampling shows enhanced contribution to be 101% in 2015, 47% in 2016 and 45.5% in 2017. The difference between the fishery and escapement seems logical as the fishery was likely comprised of mixed stocks, thus lowering the frequency of McLoughlin chum. The incredibly high enhanced contribution to escapement in 2015 (101%), compared to fishery (11%), is difficult to justify. Possible explanations include: higher survival rate of the river release compared to seapen release and natural spawners, sampling error (samplers did not record an accurate representation of the mark rate), high stray rates of seapen releases and/or a fisheries that was dominated by other chum stocks.

Survival Rate

Escapement in recent years indicates there is a differential survival rate between outer central coast chum stocks (e.g. McLoughlin Creek) and inner central coast stocks (Bella Coola River). The objective of this project was to accurately calculate survival rate of McLoughlin Creek chum and compare it to enhanced Snootli Creek chum, a tributary to the Bella Coola River. Average Snootli chum adult survival rate (including Area 8 catch) is 0.91% (ranging from 0.05 to 3.8% from 2002 to 2009). Based on two years of preliminary data, the average survival rate of McLoughlin Creek chum is 1.2% (ranging from 0.42 to 1.96%). This 1.2% is based on the 2011 and 2012 returns and is likely an underestimate, as the 5-year old age-class is missing from the fishery portion of for brood year 2012. Although the two-year average survival rate of McLoughlin Creek is greater than the average for Snootli, we cannot say with statistical certainty that outer central coast chum have a higher survival rate compared to inner central coast chum. This is due to the great variability of survival rate between years for each stock.

APPENDIX I - 2017 Financial Expenditures Summary

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

Funding Total	\$ 19,375
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Contract for Area 7 chum fishery sampling	\$ 0
Hiring of field supervisor	\$ 1,000
Travel cost for supervisor & DFO staff	\$ 1,200
Total Costs	\$ 2,200

Balance (refunded to PSC)	\$ 17,175
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