



Chum Salmon (*Oncorhynchus keta*) Escapement Surveys in the Nass Area, 2015 to 2018

Prepared by:

LGL Limited
environmental research associates
9768 Second Street
Sidney, BC V8L 3Y8

Prepared for:

Pacific Salmon Commission
600 - 1155 Robson Street
Vancouver, BC V6E 1B5

and

Nisga'a Lisims Government
Fisheries & Wildlife Department
P.O. Box 228
Gitlaxt'aamiks, BC V0J 1A0

Nisga'a Fisheries Report #18-26

31 May 2019

CHUM SALMON (*ONCORHYNCHUS KETA*)
ESCAPEMENT SURVEYS IN THE NASS AREA,
2015 TO 2018

Prepared by:

I. A. Beveridge, R. F. Alexander, S. C. Kingshott, and C. A. J. Noble

LGL Limited
environmental research associates
9768 Second Street
Sidney, BC V8L 3Y8

Prepared for:

Pacific Salmon Commission
#600 - 1155 Robson Street
Vancouver, BC V6E 1B5

and

Nisga'a Lisims Government
Fisheries & Wildlife Department
P.O. Box 228
Gitlaxt'aamiks, BC V0J 1A0

Nisga'a Fisheries Report #18-26

31 May 2019

TABLE OF CONTENTS

LIST OF TABLES.....	i
LIST OF FIGURES.....	i
LIST OF PHOTOS.....	ii
LIST OF APPENDICES.....	ii
ACKNOWLEDGEMENTS.....	iv
EXECUTIVE SUMMARY.....	v
INTRODUCTION.....	1
Objectives.....	2
METHODS.....	2
Surveyed Streams.....	2
Percent Bankfull.....	3
Walk-ability, Snorkel-ability, and Spawning Habitat Quality Scores.....	4
Walk-ability Score.....	4
Snorkel-ability Score.....	4
Spawning Habitat Quality Score.....	4
Bio-sampling.....	4
Escapement Estimation.....	4
RESULTS AND DISCUSSION.....	5
Streams Surveys.....	5
Chum Salmon Escapement Estimates.....	5
Other Salmon Counts and Escapement Estimates.....	5
Bio Samples.....	6
Water Quality.....	6
Walk-ability, Snorkel-ability, and Spawning Habitat Quality Scores.....	6
RECOMMENDATIONS.....	7
REFERENCES.....	8
TABLES.....	10
FIGURES.....	23
PHOTOS.....	37
APPENDICES.....	45

LIST OF TABLES

Table 1.	Summary of Tseax side channel Chum Salmon escapement estimates, 1994–2018.	11
Table 2.	Access methods and travel time to Nass Area Chum Salmon streams surveyed in 2018.	11
Table 3.	Survey dates, water quality, habitat quality score, countability scores, and Chum Salmon counts for Nass Area streams surveyed in 2018.....	12
Table 4.	Summary of Ksemamaith Creek Chum Salmon escapement estimates, 1994–2018.	14
Table 5.	Summary of Stagoo Creek Chum Salmon escapement estimates, 1994–2018.....	15
Table 6.	Summary of Illiance River Chum Salmon escapement estimates, 1994–2018.	16
Table 7.	Summary of Wilauks Creek Chum Salmon escapement estimates, 1994–2018.	17
Table 8.	Summary of Kitsault River Chum Salmon escapement estimates, 1994–2018.....	18
Table 9.	Summary of Kshwan River Chum Salmon escapement estimates, 1994–2018.	19
Table 10.	A comparison of Chum Salmon escapement estimates for each Nass Area system surveyed in 2018.	20
Table 11.	Nass Area Chum Salmon escapement, harvest, and exploitation rates, 1980–2018 (NJTC 2019).....	21
Table 12.	Summary of 2018 water temperature from surveyed Nass Area streams.	22
Table 13.	Summary of 2018 walk-ability, snorkel-ability, and spawning habitat quality scores for Chum Salmon survey streams in the Nass Area.	22

LIST OF FIGURES

Figure 1.	Pacific Fishery Management Area 3 and the Nass Area as defined by the Nisga’a Treaty.....	24
Figure 2.	Nass Area Chum Salmon indicator and non-indicator streams.	25
Figure 3.	The number of index (A) and non-index (B) streams surveyed by DFO with enough effort to generate escapement estimates, 1950 to 2014.	26
Figure 4.	Nass Area Chum Salmon (A) escapement and catch, and (B) exploitation rates from 1980 to 2018.....	27
Figure 4.	Nass Area Chum Salmon indicator and non-indicator streams surveyed in 2018. .	28
Figure 5.	Large beaver dam at the mouth of Tseax side channel in 2017 and 2018.....	29
Figure 6.	Ksemamaith Creek Chum Salmon survey reaches, 2018.	29
Figure 7.	Gitzyon Creek Chum Salmon survey reaches, 2018.....	30
Figure 8.	Dogfish Bay Creek reaches surveyed in 2018.	30
Figure 9.	Donahue Creek Chum Salmon survey reaches, 2018.	31

Figure 10.	Lizard Creek Chum Salmon survey reaches, 2018.	32
Figure 11.	Crag Creek Chum Salmon survey reaches, 2018.....	32
Figure 12.	Stagoo Creek Chum Salmon survey reaches, 2018.....	33
Figure 13.	Kshwan River Chum Salmon side channel and tributary survey reaches, 2018.....	34
Figure 14.	Kitsault River Chum Salmon survey reaches in 2018.	34
Figure 15.	Illiance River Chum Salmon survey reaches, 2018.....	35
Figure 16.	Wilauks Creek Chum Salmon survey reaches, 2018.	35
Figure 17.	Estimating percent bankfull based on the portion of the channel that is wetted. .	36

LIST OF PHOTOS

Photo 1.	Typical counting conditions in Ksemamaith Creek in the lower Nass.....	38
Photo 2.	Typical counting conditions in Gitzyon Creek in the lower Nass.....	38
Photo 3.	Representative images of Dogfish Bay Creek showing A) typical counting conditions and B) the canyon section upstream of reach 2.....	39
Photo 4.	Representative images of typical counting conditions in Donahue Creek.....	39
Photo 5.	Representative images of Lizard Creek on Pearse Island in Portland Inlet.	40
Photo 6.	Representative images of typical counting conditions observed in Crag Creek on Pearse Island.	40
Photo 7.	Stagoo Creek showing A) counting conditions, B) Chum Salmon redd, and C) and D) Chum Salmon spawners.....	41
Photo 8.	Representative images of A) a Kshwan River side channel and B) Chum Salmon spawners and carcasses.	42
Photo 9.	Representative images of A) Falls Creek (Kitsault River tributary) and B) a mainstem Kitsault River side channel.....	42
Photo 10.	Representative images of A) Illiance River and B) Clary Creek (Illiance tributary)..	43
Photo 11.	Representative images of Wilauks Creek, 2018.....	44
Photo 12.	Illiance River Chum Salmon carcasses collected for bio-sampling.....	44

LIST OF APPENDICES

Appendix A – Field forms.

Table A-1.	Nisga’a Fisheries and Wildlife Department Chum Salmon stream survey fish count form.	46
Table A-2.	Nisga’a Fisheries and Wildlife Department water quality, habitat, and countability scoring form.	46
Table A-3.	Nisga’a Fisheries and Wildlife Department salmon biosample form.....	47

Appendix B – Score criteria for assessing the walk-ability, snorkel-ability, and spawning habitat quality for Chum Salmon survey streams.

Table B-1.	Walk-ability score descriptions.....	48
Table B-2.	Snorkel-ability score descriptions.....	49
Table B-3.	Chum Salmon spawning habitat quality score description.....	50

Appendix C – Probability distributions of Chum Salmon AUC escapement estimates.

Figure C-1.	Probability distributions of AUC escapement estimates for Nass Area Chum Salmon streams surveyed in 2018.....	51
-------------	---	----

Appendix D – Fisheries and Oceans Canada escapement estimate classification.

Table D-1.	Fisheries and Oceans Canada classification system for Pacific salmon escapement estimate quality.	52
------------	--	----

Appendix E – Counts and escapement estimates for Pink and Sockeye salmon.

Table E-1.	Pink and Sockeye salmon counts for each Nass Area stream surveyed in 2018.	53
Table E-2.	Best escapement estimates for Pink and Sockeye salmon runs observed during surveys in the Nass Area, 2018.....	55
Photo E-1.	Sockeye Salmon observed in Clary Creek (Illiance River tributary) on 12 September 2018.....	56

ACKNOWLEDGEMENTS

We thank from Nisga'a Lisims Government (Gitlaxt'aamiks, BC), Harry Nyce Sr. (Director of Fish and Wildlife), Edward Desson (NFWD Fishery Manager), Blair Stewart (NFWD Coastal Projects Manager), Niva Percival (NFWD Fisheries Biologist), Reggie Robinson (NFWD Equipment Manager), Tanya Clayton (NFWD Administrative Assistant), and April Angus (NFWD Data Entry Technician) for their guidance, participation, and administrative support of this project. Field surveys were conducted by NFWD technicians Tim Angus, Brian Adams, Errol Nyce, Kyle Azak, Bertram McKay, Chandra Barton, and James Griffin. Skippers Richard Azak and Phillip Azak provided safe transportation of crews to coastal streams on *Xsgaagim Lisims* and *Lihlksim Lisims*, respectively.

From Fisheries and Oceans Canada (Prince Rupert, BC), we thank Corey Martens (Resource Manager – Nass/Skeena [Areas 3 to 5]) for sharing his knowledge of the survey streams in Area 3 to support the Nass Area Chum Salmon assessments.

From LGL Limited (Sidney, BC), we thank Bob Bocking and Karl English for providing information to support this report, Dawn Keller (report review and formatting), Connie Kleckner, and Rosie LaRose (report production and shipping coordination).

Finally, we thank the Pacific Salmon Commission's (Vancouver, BC) Northern Fund Committee, Fund Coordinators, Angus Mackay and Victor Keong, for all their support in coordinating and funding this project. Funding for this project was from the Northern Fund of the Pacific Salmon Commission and the Nisga'a Lisims Government. The PSC contract number for this project was NF-2018-I-27.

EXECUTIVE SUMMARY

Beveridge, I. A., R. F. Alexander, S. C. Kingshott, and C. A. J. Noble. 2019. Chum Salmon (*Oncorhynchus keta*) escapement surveys in the Nass Area, 2015 to 2018. Prepared for the Pacific Salmon Commission, Vancouver, BC, and the Nisga'a Lisims Government Fisheries and Wildlife Department, Gitlaxt'aamiks, BC by LGL Limited, Sidney, BC. Nisga'a Fisheries Report #18-26: v + 56 p.

Funding (\$77,000) received from the Pacific Salmon Commission's Northern Fund in 2018 allowed the Nisga'a Fisheries and Wildlife Department to successfully conduct escapement ground surveys for Chum Salmon (*Oncorhynchus keta*) in the Nass Area (DFO's Pacific Fisheries Management Area 3) as Year 5 of a multi-year research project started in 2014 (Beveridge and Alexander 2015; Beveridge et al. 2016, 2017a, 2018).

A total of 11 systems, including six indicator (Ksemamaith, Kshwan, Stagoo, Kitsault, Illiance, Wilauks) and five non-indicator (Donahue, Dogfish Bay, Lizard, Crag, and Gitzyon) streams, were inspected between 15 July and 14 September 2018 in the Lower Nass (2 streams), Portland Inlet (2 streams), Portland Canal (2 streams), and Observatory Inlet (5 streams). At least four surveys spanning the peak count were planned for each indicator system. In 2018, we conducted a total of 44 stream surveys for Chum Salmon (and Pink Salmon [*O. gorbuscha*]), including streams that were visited but could not be counted due to high flows and/or turbidity.

High quality escapement estimates were produced for most indicator streams in 2018. The highest Chum Salmon escapement was observed in Kshwan River (18,686) and accounted for 62% of the observed Nass Area indicator escapement (30,135). The next highest escapement was in Stagoo Creek (9,164). The total escapement for the Nass Area in 2018 was 48,487 and is the first time the escapement goal (45,000) has been met since 2006. The estimated total return to Canada and total run size of Nass Area Chum Salmon in 2018 was 49,588 and 52,700, respectively. The total run return for Nass Area Chum Salmon in 2018 was the 6th best return since 2000 with an estimated exploitation rate of 8% (2% Canadian and 6% US).

INTRODUCTION

Chum Salmon (*Oncorhynchus keta*) stocks in the Nass Area (Figure 1; Figure 2) are depressed, with returns below the provisional escapement target (45,000) in recent years (Figure 4A; Beveridge and Alexander 2015; Beveridge et al. 2016, 2017a, 2018; Nisga'a-Canada-BC Joint Technical Committee [NJTC] 2019). From 2007 to 2017, the estimated total run for Nass Area Chum Salmon returned on average 78% (79,500 fish) lower than the average return from 1980 to 2006 (22,100 vs. 102,000) and did not meet the escapement goal in these years. In response to these poor returns, Fisheries and Oceans Canada (DFO) resource managers have reduced Canadian marine exploitation rates to a mean of 3.3% (range: 0.2–7.4%) from 2007 to 2017 compared to the 1980 to 2006 mean of 22.3% (range: 5.8–43.2%; Figure 4B). Exploitation rates of Nass Area Chum Salmon in Alaskan fisheries are estimated to have also substantially declined since 2007 to a mean of 15.8% (range: 7.5–39.4%) from a mean of 28.8% (range: 8.9–56.0%) from 1980 to 2006 (NJTC 2019). As a result, on average the US fishery is harvesting 29,000 fewer Nass Area Chum Salmon each year since 2007.

While recovery of Nass Area Chum Salmon stocks has not occurred to date, there are indications that stocks may be improving. The 2015 (Beveridge et al. 2016) and 2018 (this report) Nass Area escapements were the highest observed since 2006. Historically, DFO were responsible for collecting Chum Salmon escapement on the British Columbia North Coast using stock assessment staff, Fishery Officers, and/or the Charter Patrol program. Most of these surveys were conducted on up to seven coastal escapement index streams¹ (Ksi Gingolx, Ksi X'anmas, Stagoo Creek, Wilauks Creek, Illiance River, Kitsault River, and Kshwan River). The number of annual index streams with enough data to produce an escapement estimate averaged six streams from 1950 to 2001. After 2001, DFO survey effort decreased to an average of four index streams with escapement estimates (Figure 3A). In some years, only two indicator streams were surveyed. A similar trend was observed in the assessment of non-indicator stream; but with the decline in effort beginning in the 1990s (Figure 3B). From 1950 to 1990, an average of eight streams had Chum Salmon escapement estimates, whereas from the 1990 to 2014, this average declined to three streams. Further, several methods were used to collect count data (or the method was unspecified) and to generate escapement estimates. Pre-1998, the method for estimating Chum escapement was unknown (NuSEDS). As a result, data defining the Chum Salmon decline in the Nass Area were poor (Beveridge and Alexander 2015).

Effective management of Nass Area Chum Salmon and development of a recovery plan, for DFO's Wild Salmon Policy (DFO 2009) and as a condition of the Marine Stewardship Council Certification Program for conducting sustainable commercial fisheries in Area 3, requires accurate escapement and run size data. Consistent survey effort and higher quality estimates are necessary. High quality estimates are essential to understand the current status of Nass Area Chum Salmon and to monitor population trends in the future. To achieve high quality estimates for all surveyed streams, our goal was to collect escapement data using standardized methods.

¹ The official names of Kincolith River and Kwinamass River were changed following the implementation of the Nisga'a Treaty (Nisga'a Final Agreement Appendix F-2) to Ksi Gingolx and Ksi X'anmas, respectively.

Objectives

The Wild Salmon Policy has identified 36 Chum Salmon spawning streams from three conservation units (CUs; Lower Nass; Portland Inlet; Portland Canal-Observatory Inlet) that cover the Nass Area (Figure 2). Estimates of annual Chum Salmon escapement to the Nass Area are based on surveys of up to eight (7 Coastal, 1 Lower Nass) indicator systems (22% of identified Chum Salmon streams) from these CUs (Figure 2; English et al. 2012).

Escapement surveys in 2018 represent Year 5 of a Pacific Salmon Commission (PSC) funded multi-year project to standardize Chum Salmon escapements to lower Nass and coastal streams and to develop a long-term, scientifically defensible, and cost-effective escapement program. The primary goal of Year 5 (2018) was to conduct stream surveys and collect escapement data following a standardized methodology to improve the quality of estimates. The applicability of area-under-the-curve (AUC) and other methods (e.g., peak count) were also evaluated for both indicator and non-indicator streams.

Specific objectives for Year 5 were:

1. Assess six Chum Salmon indicator systems (Kshwan River, Stagoo Creek, Kitsault River, Illiance River, Wilauks Creek, and Ksemamaith Creek) by conducting rigorous and repeatable surveys on the ground during the complete migration of Chum Salmon to those systems with a minimum of four trips planned to each system;
2. Assess up to five non-indicator Chum Salmon streams (e.g., Donahue Creek, Crag Creek, Lizard Creek, Dogfish Bay Creek, and/or other streams recommended by the NJTC) and, where Chum Salmon are found in abundance, determine if they could be added to or replace existing indicator streams; and
3. Generate aggregate Nass Area Chum Salmon escapement estimates for 2018 that are scientifically defensible and recommend methods for long-term annual estimation of Chum Salmon escapements in the Nass Area.

This report summarises our 2018 data collection, evaluates our escapement data from 2015 to 2018, and provides recommendations for future Nass Area Chum surveys.

METHODS

Surveyed Streams

Eleven Nass Area streams were surveyed for Chum Salmon escapement in 2018 by the Nisga'a Fisheries and Wildlife Department (NFWD), including six indicator and five non-indicator streams (Figure 5). In past years (2010–2016), the Tseax side channel (a groundwater channel that flows into the Tseax Slough) was surveyed by NFWD for Chum Salmon escapement. In 2017, a large beaver dam was constructed around a fallen cottonwood tree near the stream mouth (Figure 6). Due to its size, NFWD decided not to breach this dam and the Tseax side channel was not surveyed in 2017 or 2018 (Table 1).

Although Ksi Gingolx (Kincolith River; ~30 km stream length) and Ksi X'anmas (Kwinamass River; ~39 km stream length) are both indicator systems for Nass Area Chum Salmon (Figure 2), they

were not assessed in 2018 due to the challenges in counting the low numbers of Chum Salmon that return each year to these large systems. Surveyed streams were from four regions of the Nass Area: 1) Lower Nass River; 2) Portland Inlet (Areas 3-7 and 3-12); 3) Portland Canal (Areas 3-13 and 3-15); and 4) Observatory Inlet (Area 3-14; Figure 1).

Specific streams surveyed in 2018 were:

Lower Nass:

1. Ksemamaith Creek (Indicator Stream; Figure 7; Photo 1)
2. Gitzyon Creek (Figure 8; Photo 2)

Portland Canal:

3. Dogfish Bay Creek (Figure 9; Photo 3)
4. Donahue Creek (Figure 10; Photo 4)

Portland Inlet:

5. Lizard Creek (Figure 11; Photo 5)
6. Crag Creek (Figure 12; Photo 6)

Observatory Inlet:

7. Stagoo Creek (Indicator Stream; Figure 13; Photo 7).
8. Kshwan River (Indicator Stream; Figure 14; Photo 8). Surveys were conducted in:
 - a. mainstem side channels
 - b. unnamed tributaries
9. Kitsault River (Indicator Stream; Figure 15; Photo 9). Surveys were conducted in:
 - a. a mainstem side channel
 - b. Falls Creek (Kitsault tributary)
10. Illiance River (Indicator Stream; Figure 16; Photo 10)
11. Wilauks Creek (Indicator Stream; Figure 17; Photo 11)

At least four ground surveys (stream walks) spanning the peak count were planned for each system. Surveys started with Stagoo Creek on 15 July and ended with Crag Creek on 14 September. Access methods included marine vessel, zodiac, and truck and are summarized in Table 2. All fish count and habitat data were recorded on NFWF field forms (Appendix A).

During each stream walk, crews counted live Chum Salmon and carcasses on a per-reach basis (Table A-1). Live and dead counts of other salmon species were also recorded. The lead counter estimated their observer efficiency (%), considering water depth, turbidity, glare, woody debris, undercut banks, and other factors potentially limiting visibility and fish counts.

In addition to salmon counts, crews collected temperature and percent bankfull data (Table A-2), assessed stream count-ability (Appendix B), and bio-sampled (i.e., measured length; identified sex; collected otoliths) select fully intact carcasses (Table A-3).

Percent Bankfull

The percent bankfull, defined as the portion (%) of a channel that is full (wetted or flowing), was used as an estimate of the water level in each reach. It was estimated by visualizing the cross-sectional area of the stream as if it was full and then estimating the percentage of the

cross-sectional area that was actually full (Figure 18). Estimates of percent bankfull were grouped into five categories: <25%, 25–50%, 50–75%, 75–100%, and >100%.

Walk-ability, Snorkel-ability, and Spawning Habitat Quality Scores

Walk-ability Score

The ability to safely walk or wade each reach was assessed during each survey and assigned a score of 1 (Poor) to 5 (Excellent; Table B-1). This assessment included several factors such as confinement, turbidity, gradient, barriers, logjams, substrate, over stream vegetation, blowdown, and sight distance. Appendix B provides a description of the criteria used to assign walk-ability scores to each reach.

Snorkel-ability Score

The ability to snorkel each reach was also assessed during each survey and scored on a scale of 1 (Poor) to 5 (Excellent; Table B-2). Factors included in this assessment were depth, velocity, instream visibility, presence of logjams, substrate, aquatic vegetation, and access.

Spawning Habitat Quality Score

Chum Salmon typically spawn in lower stream reaches with gradients shallower than 3%, but preferred spawning areas have gradients $\leq 1\%$. Habitat spawning quality was scored from 1 (Poor) to 5 (Excellent; Table B-3) following an assessment of gradient, substrate suitability, and frequency of suitable spawning areas.

Bio-sampling

Select carcasses that were fully intact were sampled for nose-fork length (NFL; cm) and identified by sex. To check for Alaskan hatchery-origin Chum Salmon, otoliths were collected where possible and stored dry in numbered vials. Alaskan hatcheries thermally mark Chum Salmon otoliths and the releasing hatchery can be determined by examining the otoliths. Scale collection was planned for live and dead Chum Salmon in the lower Nass tributaries for aging. Not all carcasses were bio-sampled due to time constraints.

Escapement Estimation

Several escapement estimates were calculated for each stream, and where sufficient data were collected, included:

1. Area-under-the-curve (AUC; e.g., English et al. 1992; Perrin and Irvine 1990);
2. Peak live count;
3. Peak live plus cumulative carcass;
4. Peak live count times two (e.g., Cousens et al. 1982);
5. Mean count (e.g., Holt and Cox 2008); and
6. Total live count.

The AUC methodology requires estimates of the number of live fish over the run timing period (expanded from raw counts using observer efficiency) and estimates of residence time (days). Area under the curve estimates were planned for streams with live counts from three or more

complete surveys spanning the peak count. Sufficient data were collected to generate AUC estimates for three streams (Stagoo, Illiance, and Kitsault; Figure C-1) in 2018.

RESULTS AND DISCUSSION

Streams Surveys

Two to five stream walks were conducted on each Nass Area stream to count Chum Salmon and other salmon species present (Table 3; Figure 5). However, high and/or turbid flow conditions and wildlife encounters prevented or shortened surveys on several streams (e.g., Stagoo Creek; Kshwan River; Illiance River; and Dogfish Bay Creek). Poor marine conditions during our survey window prevented crew from accessing some streams (e.g., Kshwan River; Lizard Creek; and Donahue Creek).

Chum Salmon Escapement Estimates

Chum Salmon were observed in nearly every stream surveyed in 2018. Lizard, Gitzyon, and Ksemamaith creeks did not have any observable Chum Salmon and three streams had poor counts (<5; Crag, Dogfish Bay, and Wilauks creeks). Escapement estimate quality (Table D-1) ranged from 3 (high) to 5 (low; Table 4 to Table 9).

The highest peak counts of Chum Salmon were observed in Stagoo Creek (3,905; 3,765 live plus 329 carcasses) on 8 August and Kshwan River side channels (9,259; 7,672 live plus 1,587 carcasses) on 11 September. Of the indicator streams surveyed in 2018, Stagoo Creek and Kshwan River accounted for nearly all (30% and 62%, respectively) of the total estimated observed escapement (30,135) to Nass Area streams.

The best escapement estimates for each surveyed indicator system (Table 10) were input into the English et al. (2012) method to estimate the total Chum Salmon return to the Nass Area (Table 11; NJTC 2019). The estimated Nass Area escapement (48,487) was over the escapement goal (45,000; Figure 4) for the first time since 2006. This was also the fourth largest Nass Area escapement since 2000 (Table 11).

Other Salmon Counts and Escapement Estimates

In addition to Chum Salmon, Pink (*O. gorbuscha*) and Sockeye (*O. nerka*) salmon were observed during our surveys (Table E-1). Except for Gitzyon Creek, Pink Salmon were observed in all surveyed streams, although their numbers varied greatly from one fish (Lizard Creek) to over 11,000 fish (Illiance River). Both Stagoo Creek and Dogfish Bay Creek had relatively high Pink Salmon peak counts (3,712 and 4,776, respectively).

Compared with previous years, conditions in Wilauks Creek had changed considerably. Dak River flow (cold, turbid, glacial) was no longer flowing into Wilauks Creek. Only four pink were observed in Wilauks Creek in 2018, suggesting the spawners to this system used Illiance River instead; the mouths of both streams are at the same location (Figure 5). This could explain the high count in Illiance River relative to other systems.

Pink Salmon counts were sufficient to generate escapement estimates to Stago Creek, Illiance River, and Kitsault River using AUC and peak count methods (Table E-2). Peak count estimates were also calculated for Dogfish Bay Creek and Kshwan River.

Sockeye Salmon were observed in low numbers (< 5) in three Observatory Inlet streams (Table E-1; Kshwan River; Kitsault River; Illiance River). This was our first observation of Sockeye Salmon in the Illiance River system (Photo E-1). In the lower Nass, we observed a peak count of 255 Sockeye Salmon in Gitzyon Creek. These fish are part of the lower Nass sea-type Sockeye Salmon population (Beveridge et al. 2017b).

Bio Samples

Twenty-two Chum Salmon were bio-sampled from Kitsault and Illiance rivers (Photo 12). The average nose-fork length was 79 cm (range: 69 to 89 cm) and most were male (63% or 14 fish). The sex of three fish was unknown and the remaining five fish were female. Scales were collected from 12 Chum Salmon carcasses and 11 were age 4₁ (EUR 0.3) and one was age 3₁ (EUR 0.2).

Otoliths were collected from each of these fish to assess Alaskan hatchery origin and results should be available in late 2019.

Water Quality

Smaller streams (e.g., Crag Creek) experienced extremely low water levels in 2018. At Crag Creek, the stream was mostly dry upstream of the estuary on 23 August. Water levels in the larger systems (e.g., Stago Creek) were also low compared with other years.

No unusual temperatures were measured, with average temperature ranging from 7.5 °C in Kshwan River side channels to 13.4 °C in Dogfish Bay Creek (Table 12). The highest temperature (15.0 °C) was recorded in Dogfish Bay Creek on 22 August and in Crag Creek on 23 August.

The average (12.6 °C) and maximum (14 °C) temperatures in Wilauks Creek were higher in 2018 compared with 2015 to 2017 surveys (mean range = 9.8 to 11.4 °C; maximum range = 11.5 to 12.7 °C). This supports our field observations that Dak River was no longer flowing into Wilauks Creek.

Streams on Pearse Island (Lizard and Crag creeks) were tannin stained and tea coloured (Photo 5; Photo 6) with limited instream visibility, despite having low turbidity values (Table 12).

Walk-ability, Snorkel-ability, and Spawning Habitat Quality Scores

The average walk-ability in all streams was either good or excellent (Table 13). Most of the streams surveyed had poor, low, or moderate snorkel-ability (Table 13), and few good snorkel areas were observed.

Average spawning habitat quality was moderate or good in all streams (Table 13). The highest quality spawning habitats were observed in Lizard Creek, Crag Creek, Stago Creek, Illiance River, Kitsault River side channel, and the Kshwan River side channels and tributaries. The habitat quality in Ksemamaith Creek has changed (decreased) from previous years due to high bedload movement and bank erosion.

RECOMMENDATIONS

1. Continue to conduct rigorous and repeatable ground surveys of at least six Nass Area Chum Salmon indicator systems (Kshwan River, Stagoo Creek, Kitsault River, Illiance River, Wilauks Creek, and Ksemamaith Creek) with priority to marine areas of Area 3;
2. Conduct a minimum of four surveys per system to count Chum Salmon and other salmon present, with surveys spanning the peak spawning period;
3. Explore options to replace Ksemamaith Creek as a lower Nass indicator stream if counts and/or habitat conditions remain poor;
4. Discontinue ground surveys for Chum Salmon in coastal non-indicator systems (e.g., Donahue Creek, Crag Creek, Lizard Creek, and Dogfish Bay Creek). Counts in these streams were low relative to the current indicators and they are not considered to be potential indicator streams;
5. Continue to monitor the beaver dam at the mouth of Tseax side channel in 2019. Tseax side channel was not surveyed in 2017 or 2018 due to this persistent and large beaver dam built around a large fallen cottonwood. The side channel was considered a possible indicator system to be added to the lower Nass streams and be included in the NJTC annual method to estimate Nass Area Chum Salmon escapement for the lower Nass CU;
6. Start Stagoo Creek and Alice Arm streams (Illiance River, Kitsault River, and Wilauks Creek) surveys in mid to late July;
7. Evaluate survey life combined with observer efficiency for variation within and among streams surveyed; and
8. Install water level gauges in Nass Area indicator streams to assess flow conditions over the migration period and effect on Chum Salmon entry and timing into the Nass streams that are surveyed.

REFERENCES

- Beveridge, I. A., and R. F. Alexander. 2015. An evaluation of Nass Area Chum Salmon escapement data, 1980–2014. Prepared for the Pacific Salmon Commission, Vancouver, BC, and the Nisga’a Lisims Government Fisheries and Wildlife Department, New Aiyansh, BC by LGL Limited, Sidney, BC. Nisga’a Fisheries Report #14-26: v + 35 p.
- Beveridge, I. A., R. F. Alexander, S. C. Kingshott, C. A. J. Noble, and C. Braam. 2016. Data summary report for Chum Salmon escapement surveys in the Nass Area in 2015. Prepared for the Pacific Salmon Commission, Vancouver, BC, and the Nisga’a Lisims Government Fisheries and Wildlife Department, Gitlaxt’aamiks, BC, by LGL Limited, Sidney, BC. Nisga’a Fisheries Report #15-26: v + 42 p.
- Beveridge, I. A., R. F. Alexander, S. C. Kingshott, C. A. J. Noble, and C. Braam. 2017a. Data summary report for Chum Salmon escapement surveys in the Nass Area in 2016. Prepared for the Pacific Salmon Commission, Vancouver, BC, and the Nisga’a Lisims Government Fisheries and Wildlife Department, Gitlaxt’aamiks, BC by LGL Limited, Sidney, BC. Nisga’a Fisheries Report #16-26: v + 42 p.
- Beveridge, I.A., W. D. Duguid, R.F. Alexander, R.C. Bocking, R.J. Bussanich, and S. Cox-Rogers. 2017b. Gingit Creek and Lower Nass River sea-type Sockeye Salmon (*Oncorhynchus nerka*) escapement and stock characteristics: 1994 to 2015. *Can. Manusc. Rep. Fish. Aquat. Sci.* 3121: ix + 61 p.
- Beveridge, I. A., S. C. Kingshott, C. A. J. Noble, and R. F. Alexander. 2018. Nass Area Coastal Chum Salmon escapement project, 2017. Prepared for the Pacific Salmon Commission, Vancouver, BC, and the Nisga’a Lisims Government Fisheries and Wildlife Department, Gitlaxt’aamiks, BC, by LGL Limited, Sidney, BC. Nisga’a Fisheries Report #17-26: v + 55 p.
- Cousens, N. B. F., G. A. Thomas, C. G. Swan, and M. C. Healy. 1982. A review of salmon escapement estimation techniques. *Canadian Technical Report of Fisheries and Aquatic Sciences* 1108: vi + 122 p.
- DFO (Fisheries and Oceans Canada). 2009. Framework for implementation of the Wild Salmon Policy: initial lists of Conservation Units for British Columbia. DFO Canadian Science Advisory Secretariat Science Advisory Report 2009/055: 31 p.
- English, K. K., R. C. Bocking, and J. R. Irvine. 1992. A robust procedure for estimating salmon escapement based on the area under the curve method. *Canadian Journal of Fisheries and Aquatic Sciences* 49: 1982–1989.
- English, K. K., T. Mochizuki, and D. Robichaud. 2012. Review of North and Central Coast salmon indicator streams and estimating escapement, catch and run size for each salmon conservation unit. Prepared by LGL Limited, Sidney, BC, for the Pacific Salmon Foundation and Fisheries and Oceans Canada: iv + 68 p.

- Holt, K. R., and S. P. Cox. 2008. Evaluation of visual survey methods for monitoring Pacific salmon (*Oncorhynchus* spp.) escapement in relation to conservation guidelines. *Canadian Journal of Fisheries and Aquatic Sciences* 65: 212–226.
- Mathews, M. A., A. C. Blakley, R. C. Bocking, C. Y. Stephens, and N. S. Morven. 2012. Nisga'a Salmon and Steelhead Catch Monitoring Program 2006–2011. Prepared by LGL Limited, Sidney, BC, and Nisga'a Fisheries and Wildlife Department, New Aiyansh, BC, for Nisga'a Lisims Government, New Aiyansh, BC. Nisga'a Fisheries Report #11-03: vii + 115 p.
- NFWD (Nisga'a Fisheries and Wildlife Department). 2019. Nisga'a Fisheries Program: Interim report of funded 2018 projects. Report prepared by the Nisga'a Fisheries and Wildlife Department, Gitlaxt'aamiks, BC, for the Nisga'a-Canada-BC Joint Technical Committee. Nisga'a Fisheries Report #18-01: v + 61 p.
- NJTC (Nisga'a-Canada-BC Joint Technical Committee). 2019. Nass Area salmon fisheries management tables as prepared by the Nisga'a-Canada-BC Joint Technical Committee in May 2019 for the Nisga'a-Canada-BC Joint Fisheries Management Committee.
- Perrin, C. J., and J. R. Irvine. 1990. A review of survey life estimates as they apply to the area-under-the-curve method for estimating the spawning escapement of Pacific salmon. *Canadian Technical Reports in Fisheries and Aquatic Sciences* 1733: vii + 49 p.

TABLES

Table 1. Summary of Tseax side channel Chum Salmon escapement estimates, 1994–2018.

Year	No. surveys	Survey dates		Method		Peak			AUC			Escapement ^a		
		First	Last	Survey	Escapement estimate	Date	Count	Expansion	O.E. (%)	R.T. (days)	No. surveys	Estimate	NuSEDS ^b	Quality
1994	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	NI	6
1995	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	NI	6
1996	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	NI	6
1997	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	NI	6
1998	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	NI	6
1999	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	NI	6
2000	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	NI	6
2001	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	NI	6
2002	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	NI	6
2003	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	NI	6
2004	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	blank	6
2005	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	blank	6
2006	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	blank	6
2007	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	blank	6
2008	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	blank	6
2009	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	blank	6
2010	5	25-Aug	09-Sep	Walk	AUC	25-Aug	16	-	93	7	3	48	66	4
2011	7	31-Jul	15-Sep	Walk	AUC	28-Aug	32	-	92	7	7	152	152	3
2012	7	13-Aug	25-Sep	Walk	AUC	18-Sep	53	-	90	7	7	143	143	3
2013	7	01-Aug	23-Sep	Walk	AUC	12-Sep	25	-	93	7	7	97	97	3
2014	6	07-Aug	13-Sep	Walk	AUC	27-Aug	21	-	87	7	6	47	47	3
2015	5	15-Aug	23-Sep	Walk	AUC	14-Sep	80	-	90	7	5	302	302	3
2016	5	27-Jul	15-Sep	Walk	AUC	05-Sep	41	-	90	7	5	116	116	3
2017	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	NI	6
2018	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	NI	6
Min	2	27-Jul	09-Sep			25-Aug	16		87	7	3	47	47	3
Max	5	25-Aug	25-Sep			18-Sep	80		93	7	7	302	302	6
Avg	4	08-Aug	17-Sep			05-Sep	38		91	7	6	129	132	5

^a Escapement estimate quality (see Appendix Table D-1 for full description): 1, 2, & 3 = High; 4 = Medium; 5 = Low; 6 = No estimate.

^b AP = adults present; NI = not inspected; blank = no entry in NuSEDS.

Table 2. Access methods and travel time to Nass Area Chum Salmon streams surveyed in 2018.

Area	Stream	Access method	Travel	
			Time (hours)	From
Lower Nass	Ksemamaith Creek	Highway vehicle access to stream	0.5	Gitlaxt'aamiks
	Gitzyon Creek	Highway vehicle access to stream	0.1	Gitlaxt'aamiks
Portland Inlet	Lizard Creek	Marine vessel; small zodiac to shore	1.5	Gingolx
	Crag Creek	Marine vessel; small zodiac to shore	2.0	Gingolx
Portland Canal	Donahue Creek	Marine vessel; small zodiac to shore	4.0	Gingolx
	Dogfish Bay Creek	Marine vessel; small zodiac to shore	1.5	Gingolx
Observatory Inlet	Stagoo Creek	Marine vessel; small zodiac to shore	2.5	Gingolx
	Kshwan River	Marine vessel; small zodiac to shore	4.5	Gingolx
	Illiance River	Marine vessel; small zodiac to shore	4.0	Gingolx
	Wilauks Creek	Marine vessel; small zodiac to shore	4.0	Gingolx
	Kitsault River tributary (Falls Creek) and side channel	Marine vessel; foot or vehicle access from Alice Arm dock	5.0	Gingolx

Table 3. Survey dates, water quality, habitat quality score, countability scores, and Chum Salmon counts for Nass Area streams surveyed in 2018.

Survey			Average water and habitat quality		Countability score		Chum counts				Comments		
Area	Stream name	Date	Length (m)	Temp (°C)	Habitat score	Walk	Snorkel	Observer efficiency	Raw live	Expanded live		Carcass	
Lower Nass	Ksemamaith Creek	04-Aug-2018	700	11.0	3	5	1	90%	0	0	0	Habitat impacted by high flows	
		15-Aug-2018	700	NR	3	5	1	90%	0	0	0		
		07-Sep-2018	700	10.0	3	5	1	90%	0	0	0		
	Tseax Slough	24-Aug-2018	1,500	11.0	NR	NR	NR	NR	90%	20	22	3	Spawners observed
		07-Sep-2018	1,500	NR	NR	NR	NR	NR	80%	10	13	0	
	Gitzyon Creek	04-Aug-2018	1,500	13.0	4	3	1	80%	0	0	0		
15-Aug-2018		1,500	12.5	4	3	1	95%	0	0	0			
25-Aug-2018		1,000	NR	4	3	1	80%	0	0	0			
Portland Inlet	Crag Creek	23-Aug-2018	500	15.0	NR	NR	NR	100%	0	0	0	Extreme low water on first survey	
		03-Sep-2018	3,000	12.0	NR	NR	NR	80%	0	0	0		
		14-Sep-2018	3,000	11.0	3	3	2	95%	2	2	0		
	Lizard Creek	23-Aug-2018	2,000	15.0	NR	NR	NR	90%	0	0	0		
		03-Sep-2018	1,500	11.0	NR	NR	NR	60%	0	0	0		
		15-Sep-2018	0									Poor marine conditions prevented crew access	
Portland Canal	Donahue Creek	09-Aug-2018	0										Poor marine conditions prevented crew access
		22-Aug-2018	0										Poor marine conditions prevented crew access
		01-Sep-2018	800	8.0	NR	NR	NR	70%	16	23	0		
	Dogfish Bay Creek	13-Sep-2018	800	7.0	3	2	2	90%	7	8	2		
		09-Aug-2018	1,400	NR	3	4	1	90%	2	2	0	Wolves and black bear in area	
	22-Aug-2018	1,400	15.0	3	5	1	95%	0	0	0			
Observatory Inlet	Stagoo Creek	01-Sep-2018	800	12.5	NR	NR	NR	80%	0	0	0	Bear encounter limited survey	
		13-Sep-2018	1,400	9.0	4	4	2	90%	0	0	0		
		15-Jul-2018	2,000	8.3	3	4	2	68%	3	5	0	Bear encounter limited survey	
		29-Jul-2018	3,200	9.0	5	4	2	71%	2,504	3,765	8	Survey incomplete due to high flow	
		08-Aug-2018	4,500	8.5	NR	NR	NR	90%	3,218	3,576	329		
	20-Aug-2018	4,500	8.0	5	4	1	58%	634	1,116	184			
	29-Aug-2018	0										No survey due to high turbid flow	

Table 3 continued.

Survey			Average water and habitat quality		Countability score		Chum counts				Comments		
Area	Stream name	Date	Length (m)	Temp (°C)	Habitat score	Walk	Snorkel	Observer efficiency	Raw live	Expanded live		Carcass	
		31-Jul-2018	100	8.0	4	5	1	60%	0	0	0	High turbidity in side channels (could not be surveyed)	
	Kitsault River ^a	07-Aug-2018	900	10.3	NR	NR	NR	90%	4	4	0		
		16-Aug-2018	900	10.3	4	5	1	100%	95	95	11		
		28-Aug-2018	0										Flooding so could not be surveyed
		12-Sep-2018	900	7.5	4	5	2	93%	142	156	153		
	Illiance River	30-Jul-2018	1,800	12.0	3	4	2	72%	13	22	1		
		06-Aug-2018	1,800	12.0	NR	NR	NR	86%	275	323	0		
		17-Aug-2018	1,800	11.3	5	4	1	83%	441	572	55		
		28-Aug-2018	0										Flooding so could not be surveyed
	12-Sep-2018	1,800	8.5	4	4	2	79%	50	64	30			
Observatory Inlet		Wilauks Creek	30-Jul-2018	1,000	10.6	4	5	1	95%	1	1	0	
			06-Aug-2018	1,900	13.6	NR	NR	NR	90%	1	1	0	
			17-Aug-2018	1,700	14.0	3	4	1	100%	0	0	0	
	28-Aug-2018		0										Flooding so could not be surveyed
	Kshwan River	18-Aug-2018	800	9.0	3	4	1	100%	27	27	0		
		19-Aug-2018	3,800	8.0	4	4	1	75%	174	256	28		
		27-Aug-2018	1,100	10.0	NR	NR	NR	95%	29	32	0		
		28-Aug-2018	0										Survey cancelled due to flood conditions and high turbidity
		10-Sep-2018	1,100	9.5	2	4	1	87%	50	82	2		
		11-Sep-2018	3,800	7.5	4	4	1	79%	5,851	7,672	1,587		
	27-Sep-2018	0											Poor marine conditions and flooding prevented survey
		28-Sep-2018	0										Poor marine conditions and flooding prevented survey

NR = not recorded

^a Kitsault River surveys included a mainstem sidechannel and the first 100 m of Falls Creek.

Table 4. Summary of Ksemamaith Creek Chum Salmon escapement estimates, 1994–2018.

Year	No. surveys	Survey dates		Method	Escapement estimate	Peak			AUC		Escapement ^a			
		First	Last			Date	Count	Expansion	O.E. (%)	R.T. (days)	No. surveys	Estimate	NuSEDS ^b	Quality
1994	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	NI	6	
1995	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	NI	6	
1996	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	NI	6	
1997	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	NI	6	
1998	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	NI	6	
1999	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	NI	6	
2000	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	NI	6	
2001	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	NI	6	
2002	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	NI	6	
2003	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	NI	6	
2004	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	blank	6	
2005	4	31-Jul	10-Sep	Walk	AUC	19-Aug	19	-	98	7	4	83	70	4
2006	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	blank	6
2007	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	blank	6
2008	0	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	-	blank	6
2009	2	31-Aug	10-Sep	Walk	Peak Live + Dead	31-Aug	23	2.2	-	-	-	-	51	3
2010	5	23-Aug	22-Sep	Walk	AUC	26-Aug	29	-	92	7	5	82	68	4
2011	4	31-Jul	22-Sep	Walk	AUC	28-Aug	18	-	78	7	4	80	80	3
2012	8	06-Aug	21-Sep	Walk	AUC	13-Aug	11	-	88	7	4	32	32	3
2013	6	01-Aug	12-Sep	Walk	AUC	27-Aug	8	-	92	7	5	20	20	3
2014	6	07-Aug	13-Sep	Walk	AUC	14-Aug	11	-	87	7	6	25	25	3
2015	5	06-Aug	14-Sep	Walk	AUC	24-Aug	41	-	85	7	4	91	91	3
2016	5	27-Jul	15-Sep	Walk	AUC	05-Sep	13	-	90	7	4	51	51	3
2017	6	27-Jul	26-Sep	Walk	No Estimate	31-Aug	2	-	-	-	-	-	AP	6
2018	4	04-Aug	07-Sep	Walk	No Estimate	n/a	-	-	-	-	-	-	NO	6
Min	2	27-Jul	07-Sep			13-Aug	2	2.2	78	7	4	20	20	3
Max	8	31-Aug	26-Sep			05-Sep	41	2.2	98	7	6	91	91	6
Avg	5	06-Aug	15-Sep			24-Aug	19	2.2	89	7	5	58	54	5

^a Escapement estimate quality (see Appendix Table D-1 for full description): 1, 2, & 3 = High; 4 = Medium; 5 = Low; 6 = No estimate.

^b AP = adults present; NI = not inspected; NO = none observed; blank = no entry in NuSEDS.

Table 5. Summary of Stagoo Creek Chum Salmon escapement estimates, 1994–2018.

Year	No. surveys	Survey dates		Method	Escapement estimate ^a	Peak Date	Peak		AUC			Escapement ^b		
		First	Last				Survey	Count	Expansion	O.E. (%)	R.T. (days)	No. surveys	Estimate	NuSEDS
1994	8	30-Jun	08-Sep	Walk, Plane	Not Specified	03-Aug	3,500	2.9				-	10,000	4
1995	8	06-Aug	07-Oct	Walk, Plane	Not Specified	06-Aug	6,500	1.5				-	10,000	3
1996	9	24-Jul	29-Aug	Walk, Plane	Not Specified	18-Aug	1,275	3.1				-	4,000	5
1997	5	06-Aug	04-Sep	Walk, Plane	Not Specified	09-Aug	500	4.0				-	2,000	5
1998	13	16-Jul	22-Oct	Walk, Plane, Heli	Not Specified	01-Aug	20,000	1.5				-	30,000	3
1999	7	01-Aug	15-Sep	Walk, Plane, Heli	Not Specified	07-Aug	8,706	2.0				-	17,000	3
2000	7	02-Aug	13-Sep	Walk, Plane, Heli	Not Specified	14-Aug	4,140	1.6				-	6,500	3
2001	6	29-Jul	10-Sep	Walk, Plane, Heli	Not Specified	11-Aug	9,511	1.6				-	15,000	4
2002	3	11-Aug	10-Sep	Walk, Heli	Not Specified	21-Aug	3,100	1.6				-	5,000	4
2003	6	25-Jul	25-Aug	Walk, Heli	Not Specified	11-Aug	18,050	1.7				-	30,000	4
2004	6	02-Jul	31-Aug	Walk, Heli	Expert Opinion	13-Aug	8,520	1.4				-	12,000	3
2005	6	13-Jul	03-Sep	Walk (5), Heli (1)	Expert Opinion	08-Aug	7,500	2.0	80	10	3	16,506	15,000	3
2006	6	25-Jul	02-Sep	Walk	AUC	04-Aug	6,140		100	13	4	13,162	13,000	3
2007	5	27-Jul	13-Sep	Walk	AUC	27-Jul	2,740		100	15	5	4,894	4,900	3
2008	4	29-Jul	08-Sep	Walk	AUC	22-Aug	172		100	10	4	633	640	3
2009	5	18-Jul	07-Sep	Walk	AUC	08-Aug	5,559		100	12	5	9,800	9,800	3
2010	4	15-Jul	05-Sep	Walk	AUC	11-Aug	2,000		85	10	4	4,193	4,200	4
2011	3	27-Jul	16-Sep	Walk	Peak Live + Cum. Dead	-	1,868	1.2				-	2,200	4
2012	6	25-Jul	16-Sep	Walk	AUC	-			100	14	3	7,925	7,925	3
2013	3	31-Jul	02-Sep	Walk	Expert Opinion	31-Jul	6,500	1.1				-	7,100	4
2014	3	27-Jul	12-Sep	Walk	AUC	-			60	10	3	8,117	8,200	4
2015	4	27-Jul	29-Aug	Walk	Peak count x 2	09-Aug	3,553	2.0				-	6,758	4
2016 ^c	5	15-Jul	06-Sep	Walk	AUC	06-Aug	2,756	-	62	10	4	8,139	8,139	3
2017 ^d	2	16-Jul	06-Sep	Walk	Peak count x 2	06-Aug	6,804	2.0				-	6,804	4
2018 ^e	4	15-Jul	20-Aug	Walk	AUC	08-Aug	7,810	-	75	10	4	9,164	9,164	3
Min	2	30-Jun	20-Aug			27-Jul	172	1.1	60	10	3	633	640	3
Max	13	11-Aug	22-Oct			22-Aug	20,000	4.0	100	15	5	16,506	30,000	5
Avg	6	23-Jul	08-Sep			08-Aug	5,965	1.9	86	11	4	8,253	9,813	4

^a From DFO BC16 records and Stream Estimate Narrative data.

^b Escapement estimate quality (see Appendix Table D-1 for full description): 1, 2, & 3 = High; 4 = Medium; 5 = Low; 6 = No estimate.

^c Six surveys were attempted but high turbid flows cancelled two surveys (25 July & 26 August).

^d Six surveys were attempted but high turbid flows limited (29 July) or prevented (16, 26 August; 6 September) four surveys.

^e A scheduled survey on August 29 was cancelled due to high, turbid, and unsafe flows.

Table 6. Summary of Illiance River Chum Salmon escapement estimates, 1994–2018.

Year	No. surveys	Survey dates		Method		Peak			AUC			Escapement ^b		
		First	Last	Survey	Escapement estimate ^a	Date	Count	Expansion	O.E. (%)	R.T. (days)	No. surveys	Estimate	NuSEDS	Quality
1994	4	20-Jul	12-Sep	Walk	Not Specified	27-Aug	1,650	2.4				-	4,000	3
1995	10	20-Jul	09-Oct	Walk	Not Specified	01-Aug	2,377	1.7				-	4,000	3
1996	10	20-Jul	05-Oct	Walk	Not Specified	13-Aug	184	2.2				-	400	3
1997	9	09-Aug	10-Oct	Walk, Heli	Not Specified	07-Sep	227	1.5				-	350	3
1998	13	16-Jul	11-Oct	Walk, Heli	Not Specified	11-Aug	1,044	2.9				-	3,000	3
1999	10	26-Jul	05-Oct	Walk	Not Specified	20-Aug	401	3.7				-	1,500	4
2000	10	03-Aug	12-Oct	Walk	Not Specified	09-Sep	678	1.8				-	1,200	3
2001	12	31-Jul	12-Oct	Walk	Not Specified	30-Aug	290	3.4				-	1,000	3
2002	1	20-Aug	-	Walk	No Estimate	-	520					-	AP	6
2003	1	28-Aug	-	Walk	No Estimate	-	568					-	AP	6
2004	3	09-Aug	08-Sep	Walk	Expert Opinion	09-Aug	437	3.4				-	1,500	5
2005	9	08-Jul	19-Sep	Walk	Expert Opinion	17-Aug	178	1.7				-	300	4
2006 ^c	3	08-Aug	11-Sep	Walk	AUC	27-Aug	884		80	10	3	1,806	1,800	4
2007	1	-	-	Not Recorded	No Estimate	-	12					-	AP	6
2008	2	07-Aug	09-Sep	Walk	No Estimate	-	8					-	AP	6
2009	4	10-Aug	24-Sep	Walk	AUC	24-Aug	209		100	10	3	472	475	3
2010	4	17-Jul	15-Sep	Walk	Expert Opinion	10-Aug	116	1.5				-	170	4
2011	7	26-Jul	15-Sep	Walk	No Estimate	-	19					-	AP	6
2012	5	23-Jul	06-Sep	Walk	Expert Opinion	-							113	3
2013	2	29-Jul	21-Aug	Walk	No Estimate	-							AP	6
2014	4	31-Jul	14-Sep	Walk	AUC	08-Aug	299	-	90	10	3	419	419	3
2015	5	03-Aug	16-Sep	Walk	AUC	16-Aug	673	-	61	10	5	1,836	1,836	3
2016 ^d	5	26-Jul	07-Sep	Walk	AUC	26-Jul	268	-	69	10	4	902	902	3
2017 ^e	5	30-Jul	07-Sep	Walk	Maximum count x 2	- ^f	141	2.0				-	282	5
2018 ^g	5	30-Jul	12-Sep	Walk	AUC	17-Aug	572	-	80	10	4	1,828	1,828	3
Min	1	08-Jul	21-Aug			26-Jul	8	1	61	10	3	419	113	3
Max	13	28-Aug	12-Oct			09-Sep	2,377	4	100	10	5	1,836	4,000	6
Avg	6	30-Jul	20-Sep			17-Aug	511	2	80	10	4	1,211	1,320	4

^a For 1994 to 2014, from DFO BC16 records and Stream Estimate Narrative data. Estimates for 2015–2018 are from PSC funded NFWD surveys.

^b Escapement estimate quality (see Appendix Table D-1 for full description): 1, 2, & 3 = High; 4 = Medium; 5 = Low; 6 = No estimate. AP = adults present.

^c Two AUC estimates were produced in 2006 using different values for survey life (10 d & 15 d). Using 15 d survey life, the escapement estimate was 1,204. The estimate using 10 d survey life was used for NuSEDS.

^d Six surveys were attempted but a survey on 26 August was prevented by high turbid flows.

^e Five surveys were attempted but three surveys were prevented by high turbid flows (16, 26 August) and marine vessel mechanical issues.

^f The peak count was missed due to weather. The count shown is the maximum Chum Salmon count for 2017.

^g A scheduled August 29 survey was cancelled due to unsafe flood conditions and high turbidity.

Table 7. Summary of Wilauks Creek Chum Salmon escapement estimates, 1994–2018.

Year	No. of surveys	Survey dates		Method		Peak			AUC			Escapement ^b		
		First	Last	Survey	Escapement estimate ^a	Date	Count	Expansion	O.E. (%)	R.T. (days)	No. surveys	Estimate	NuSEDS ^c	Quality
1994	3	20-Jul	12-Sep	Walk	Not Specified	20-Aug	236	1.7					400	5
1995	9	20-Jul	09-Oct	Walk	Not Specified	01-Aug	532	1.9					1,000	5
1996	10	20-Jul	05-Oct	Walk	Not Specified	13-Aug	115	3.9					450	4
1997	5	09-Aug	07-Sep	Walk	Not Specified	07-Sep	85	1.8					150	4
1998	13	16-Jul	23-Oct	Plane, Walk	Not Specified	11-Aug	413	4.8					2,000	3
1999	9	05-Aug	05-Oct	Walk	Not Specified	20-Aug	132	2.3					300	4
2000	10	03-Aug	31-Oct	Walk	Not Specified	17-Aug	95	3.2					300	4
2001	12	31-Jul	29-Oct	Walk	Not Specified	30-Aug	139	1.8					250	3
2002	1	20-Aug	-	Walk	No Estimate	20-Aug	149	-					AP	6
2003	1	-	-	Volunteer	No Estimate	-	86	-					AP	6
2004	3	09-Aug	08-Sep	Walk	Expert Opinion	20-Aug	191	2.1					400	4
2005	7	23-Jul	09-Sep	Walk	AUC	17-Aug	108	-	70	10	5	263	260	4
2006	3	08-Aug	11-Sep	Walk	No Estimate	08-Aug	13	-					AP	6
2007	-	-	-	Not Surveyed	No Estimate	-	-	-					NO	6
2008	2	07-Aug	09-Sep	Walk	No Estimate	-	2	-					AP	6
2009	4	10-Aug	24-Sep	Walk	Expert Opinion	10-Aug	26	2.3					60	4
2010	3	17-Jul	15-Sep	Walk	No Estimate	10-Aug	3	-					AP	6
2011	-	-	-	Not Surveyed	No Estimate	-	-	-					NI	6
2012	5	23-Jul	06-Sep	Walk	Expert Opinion	16-Aug	51	-				-	56	5
2013	2	29-Jul	21-Aug	Walk	No Estimate	-	-	-					NO	6
2014	3	08-Aug	14-Sep	Walk	AUC	-	-	-	75	10	3	63	63	4
2015	4	03-Aug	16-Sep	Walk	AUC	26-Aug	215	-	80	10	4	449	449	3
2016 ^d	5	27-Jul	07-Sep	Walk	AUC	17-Aug	217	-	67	10	4	418	418	3
2017 ^e	5	30-Jul	07-Sep	Walk	Maximum count x 2	- ^f	31	2.0				-	62	5
2018 ^g	3	30-Jul	17-Aug	Walk	No Estimate	-	-	-					NO	6
Min	1	16-Jul	17-Aug			01-Aug	2	1.7	67	10	3	63	56	3
Max	13	20-Aug	31-Oct			07-Sep	532	4.8	80	10	5	449	2,000	6
Avg	6	31-Jul	19-Sep			17-Aug	145	2.5	73	10	4	298	414	5

^a From DFO BC16 records and Stream Estimate Narrative data for 1994 to 2014.

^b Escapement estimate quality (see Appendix Table D-1 for full description): 1, 2, & 3 = High; 4 = Medium; 5 = Low; 6 = No estimate.

^c AP = adults present; NI = not inspected; NO = none observed.

^d Five surveys were attempted but the first survey (27 July) was cancelled due to an encounter with a sow grizzly and cubs.

^e Five surveys were attempted but three surveys were prevented by high turbid flows (16, 26 August) and marine vessel mechanical issues (7 August).

^f The peak count was missed due to weather. The count shown is the maximum Chum Salmon count for 2017.

^g No Dak River water in Wilauks Creek in 2018.

Table 8. Summary of Kitsault River Chum Salmon escapement estimates, 1994–2018.

Year	No. surveys ^a	Survey dates		Tributaries surveyed ^b	Dak River surveyed	Method		Peak			AUC			Escapement ^c		
		First	Last			Survey	Escapement estimate	Date	Count	Expansion	O.E. (%)	R.T. (days)	No. surveys	Estimate	NuSEDS ^d	Quality
1994	1–7	01-Jul	13-Sep	6	Y	Boat, Walk	Not Specified	28-Aug	4,098	2.1	-	-	-	8,500	4	
1995	2–9	14-Jul	18-Sep	7	Y	Walk	Not Specified	02-Aug	4,278	1.4	-	-	-	6,000	4	
1996	5–10	15-Jul	22-Sep	7	Y	Walk	Not Specified	18-Aug	506	2.6	-	-	-	1,320	4	
1997	1–3	01-Aug	04-Sep	5	N	Walk	No Estimate	04-Sep	69	-	-	-	-	AP	6	
1998	2–13	16-Jul	31-Oct	7	Y	Plane, Walk	Not Specified	20-Aug ^f	3,630	3.5	-	-	-	12,530	4	
1999	1–5	25-Jul	05-Oct	7	Y	Walk	Not Specified	17-Aug	503	3.0	-	-	-	1,500	4	
2000	2–9	02-Aug	09-Oct	6	Y	Walk	Not Specified	31-Aug	197	8.6	-	-	-	1,696	4	
2001	3–13	21-Jul	21-Oct	7	Y	Walk	Not Specified	21-Aug	609	1.4	-	-	-	870	4	
2002	-	-	-	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	AP	6	
2003 ^e	1	28-Aug	-	1	Y	Walk	No Estimate	-	333	-	-	-	-	AP	6	
2004	1–5	02-Aug	08-Oct	7	Y	Walk	No Estimate	05-Aug	555	-	-	-	-	AP	6	
2005	1–7	25-Jul	01-Oct	7	N	Walk	No Estimate	12-Aug	116	-	-	-	-	AP	6	
2006	1–3	19-Jul	16-Sep	7	Y	Walk, Heli (Dak)	No Estimate	16-Sep	352	-	-	-	-	AP	6	
2007	-	-	-	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	NI	6	
2008	1	07-Aug	-	3	N	Walk	No Estimate	-	-	-	-	-	-	AP	6	
2009	-	-	-	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	NI	6	
2010	1	31-Aug	-	2	N	Walk	No Estimate	-	122	-	-	-	-	AP	6	
2011	5	09-Aug	14-Sep	3	N	Walk	No Estimate	-	14	-	-	-	-	AP	6	
2012	4	25-Jul	06-Sep	-	N	Walk	Expert Opinion	20-Aug	69	-	-	-	-	AP	6	
2013	4	29-Jul	05-Sep	4	N	Walk	No Estimate	-	-	-	-	-	-	AP	6	
2014	-	-	-	-	-	Not Surveyed	No Estimate	-	-	-	-	-	-	NI	6	
2015 ^g	5	04-Aug	19-Sep	5	N	Walk	AUC	07-Sep	235	-	87	10	4	445	445	3
2016 ^h	6	26-Jul	07-Sep	2	N	Walk	AUC	07-Aug	132	-	71	10	4	351	351	3
2017 ^h	5	30-Jul	07-Sep	2	N	Walk	Maximum count x 2	- ⁱ	37	2.0	-	-	-	74	5	
2018	4	31-Jul	12-Sep	2	N	Walk	AUC	12-Sep	309	-	86	10	4	457	457	3
Min	0	31-Dec	31-Dec	1	-	-	-	02-Aug	14	1.4	71	10	4	351	74	3
Max	13	31-Aug	31-Oct	7	-	-	-	16-Sep	4,278	8.6	-	-	-	12,530	6	-
Avg ^j	4	16-Jul	07-Sep	5	-	-	-	22-Aug	1,736	3.2	-	-	-	4,631	5	-

^a Several Kitsault River tributaries are assessed as part of the Kitsault surveys. The number of surveys conducted in each tributary varied each year.

^b Prior to 2015, tributaries assessed in a given year can include: Kitsault River side-channels, Dak River, Falls Creek, Gwunya Creek, La Rose Creek, Klayduc Creek, LayaII Creek, and Stark Creel

^c Escapement estimate quality (see Appendix Table D-1 for full description): 1, 2, & 3 = High; 4 = Medium; 5 = Low; 6 = No estimate.

^d AP = adults present; NI = not inspected.

^e Volunteer counts of Falls, Gwunya, and Klayduc creeks were also made (before 8 August) but no SILs records.

^f Peak date is for Dak River.

^g Tributaries assessed by NFWD in 2015 were Falls, Gwunya, La Rose, and Klayduc creeks and a mainstem side channel. The final survey on 19 September was prevented by flood conditions.

^h Tributaries assessed by NFWD in 2016 and 2017 were Falls Creek and a mainstem side channel. Flood conditions prevented surveys on 26 August 2016. Floods also prevented surveys on 30 July and 16, 26 August 2017. A vessel mechanical issue prevented a survey planned for 7 August 2017.

ⁱ Peak not surveyed in 2017 due to flooding and access issues. Count shown in for the only complete 2017 survey conducted on 7 September.

^j Average dates exclude 2008 (single volunteer count); average number of surveys from 2010 to 2017.

Table 9. Summary of Kshwan River Chum Salmon escapement estimates, 1994–2018.

Year	No. surveys	Survey dates		Method		Peak			AUC			Escapement ^b		
		First	Last	Survey	Escapement estimate ^a	Date	Count	Expansion	O.E. (%)	R.T. (days)	No. surveys	Estimate	NuSEDS ^c	Quality
1994	1	23-Jul	-	Walk	No Estimate	-							NI	6
1995	2	27-Aug	21-Sep	Walk	Not Specified	-	5,265	1.9				-	10,000	4
1996	2	22-Aug	07-Sep	Walk	Not Specified	-	6,575	1.5				-	10,000	5
1997	1	07-Sep	-	Walk	Not Specified	-	4,849	2.1				-	10,000	5
1998	3	01-Aug	07-Oct	Walk	Not Specified	09-Sep	36,090	1.4				-	50,000	4
1999	1	15-Sep	-	Walk	Expert Opinion	-	147	13.6				-	2,000	5
2000	1	22-Sep	-	Walk	Expert Opinion	-	211	9.5				-	2,000	5
2001	1	17-Sep	19-Oct	Walk	Expert Opinion	-	724	2.8				-	2,000	5
2002	1	21-Sep	-	Walk	Expert Opinion	-	1,261	2.4				-	3,000	5
2003	1	23-Sep	24-Sep	Walk	Expert Opinion	-	1,988	2.5				-	5,000	5
2004	1	06-Sep	-	Walk	Expert Opinion	-	7,772	1.9				-	15,000	5
2005	2	17-Aug	11-Sep	Walk	Expert Opinion	-	1,043	1.9				-	2,000	5
2006	3	13-Aug	12-Sep	Walk	Expert Opinion	12-Sep	9,920	1.5				-	15,000	5
2007	2	31-Aug	12-Sep	Walk	Expert Opinion	-	519	1.9				-	1,000	5
2008	1	15-Sep	-	Walk	Expert Opinion	-	977	1.0				-	1,000	6
2009	3	13-Sep	25-Sep	Walk	Expert Opinion	14-Sep	769	2.0				-	1,500	4
2010	1	16-Sep	-	Walk	Expert Opinion	-	381	1.3				-	500	5
2011	1	15-Sep	-	Walk	Expert Opinion	-	1,162	1.0				-	1,170	5
2012	2	15-Sep	16-Sep	Walk	Expert Opinion	16-Sep	873	1.3				-	1,100	4
2013	-	-	-		Unknown	-							1,100	
2014	-	-	-	Not Surveyed	-	-	-						NI	6
2015 ^d	8	31-Aug	02-Oct	Walk	Peak Count x 2	10-Sep	8,640	2.0				-	17,400	3
2016 ^e	5	19-Aug	21-Sep	Walk	AUC	27-Aug	1,381	2.4	70	10	3	3,265	3,265	3
2017 ^f	4	17-Aug	20-Sep	Walk	Peak Count x 2	20-Sep	3,636	2.0				-	7,272	4
2018 ^g	5	18-Aug	11-Sep	Walk	Peak Count x 2	11-Sep	9,343	2.0				-	18,686	4
Min	1	23-Jul	07-Sep			27-Aug	147	1.0	70	10	3	3,265	500	3
Max	8	23-Sep	19-Oct			20-Sep	36,090	13.6	70	10	3	3,265	50,000	6
Avg	2	01-Sep	21-Sep			11-Sep	4,706	2.8	70	10	3	3,265	7,826	5

^a 1994–2011 from DFO BC16 records and Stream Estimate Narrative data.

^b Escapement estimate quality (see Appendix Table D-1 for full description): 1, 2, & 3 = High; 4 = Medium; 5 = Low; 6 = No estimate.

^c NI = not inspected.

^d Flood conditions (high turbid flow) prevented or limited surveys on 21 September and 1, 2 October.

^e High flows prevented access to river left tributaries on 19, 27 August, and 8 September. A grizzly encounter limited a survey on 21 September.

^f Flood conditions prevented surveys on 17, 26 August, and 8 September.

^g Flood conditions and poor marine weather prevented final survey planned for September 27–28, 2018.

Table 10. A comparison of Chum Salmon escapement estimates for each Nass Area system surveyed in 2018. Bold estimates are considered the best estimate for each system. NA indicates insufficient data for calculating the escapement estimate.

Area	Stream name	Indicator	Funding source	Site visits ^a	Surveys	Chum Salmon escapement estimate					
						Peak live	Peak live + Cum. dead	Peak count x 2 ^{b,c}	Mean count	Total live	AUC ^d
Lower Nass	Ksemamaith Creek	Yes	NFWD	3	3	NA	NA	NO	NA	NO	NA
	Gitzyon Creek	No	NFWD	3	3	NA	NA	NO	NA	NO	NA
Portland Inlet	Lizard Creek	No	PSC	3	2	NA	NA	NO	NA	NO	NA
	Crag Creek	No	PSC	3	3	NA	NA	AP	NA	2	NA
Portland Canal	Donahue Creek	No	PSC	2	2	23	23	46	16	31	NA
	Dogfish Bay Creek	No	PSC	4	4	NA	NA	AP	NA	2	NA
Observatory Inlet	Stagoo Creek	Yes	PSC	5	4	3,765	3,773	7,810	2,116	8,462	9,164
	Illiance River	Yes	PSC	5	4	572	628	1,254	245	981	1,828
	Wilauks Creek	Yes	PSC	4	3	NA	NA	AP	NA	1	NA
	Kitsault River	Yes	PSC	5	4	156	320	618	85	255	457
	Kshwan River	Yes	PSC	6	5	7,672	9,289	18,686	3,891	8,069	NA

^a Includes dates where crew visited a system but could not conduct a survey due to unsafe and/or poor counting conditions.

^b Estimate is based on the observation that peak counts can underestimate weir counts by 30 to 50% (Cousens et al. 1982).

The peak count is the highest live count plus carcasses observed on that day.

^c AP = adults present; NO = none observed.

^d NA = insufficient number of complete surveys to calculate an AUC estimate.

Table 11. Nass Area Chum Salmon escapement, harvest, and exploitation rates, 1980–2018 (NJTC 2019).

Year	Escapement to Nass Area indicator streams ^a								Nass Area escapement			Canadian harvests			Exploitation rates							
	Illiance River	Kitsault River	Ksemamaith Creek	Kshwan River	Kincolith River	Kwinamass River	Stagoo Creek	Wilauks Creek	Obs. ^b	EF ^c	Est. ^d	Nisga'a ^e	Other ^f	Total	Total return to Canada	US harvest ^g	Total run	Nisga'a	Other Can.	US	Total	
1980	3,000	8,600		20,000	100	800	1,500	1,000	35,000	1.6	55,070		55,777	55,777	110,847	141,011	251,858			22%	56%	78%
1981	500	3,700	10	4,000	200	500	1,500	100	10,510	1.6	16,514		7,891	7,891	24,406	23,891	48,297			16%	49%	66%
1982	400	800	25	10,000		100	500	100	11,925	1.6	18,808		10,581	10,581	29,389	6,082	35,470			30%	17%	47%
1983	2,500	5,300	20	10,000	25	100	12,000	550	30,495	1.6	47,916		40,513	40,513	88,429	33,071	121,500			33%	27%	61%
1984	5,000	6,500		8,000	200	500	15,000	1,000	36,200	1.6	56,958		62,955	62,955	119,914	42,679	162,593			39%	26%	65%
1985	1,500	1,000		20,000	1	500	2,000	250	25,251	1.6	39,731		18,274	18,274	58,005	15,971	73,976			25%	22%	46%
1986	1,200	3,000		20,000		150	2,500	75	26,925	1.6	42,524		24,323	24,323	66,847	49,602	116,448			21%	43%	63%
1987	1,300	2,250	25	15,000		50	3,600		22,225	1.6	35,664		23,470	23,470	59,134	21,543	80,677			29%	27%	56%
1988	350	1,500	100	15,000		100	1,000	250	18,300	1.6	28,862		8,755	8,755	37,618	20,601	58,218			15%	35%	50%
1989	2,000	3,000	20	10,000	20		10,000		25,040	1.6	40,555		22,764	22,764	63,320	39,051	102,371			22%	38%	60%
1990	10,000	1,000	20	6,500			8,000	500	26,020	1.6	41,108		19,398	19,398	60,506	36,677	97,183			20%	38%	58%
1991	1,000	1,000	20	10,000		100			12,120	2.2	26,934		19,563	19,563	46,498	14,869	61,367			32%	24%	56%
1992	1,506	3,000				100	3,500	700	8,806	3.2	28,325	200	25,291	25,491	53,817	13,223	67,040	0%		38%	20%	58%
1993	2,000	5,000		50,000		100	5,000	300	62,400	1.6	98,438	416	139,756	140,172	238,610	84,873	323,483	0%		43%	26%	70%
1994	4,000	8,500				10	10,000	400	22,910	3.2	73,692	579	31,181	31,760	105,452	43,990	149,443	0%		21%	29%	51%
1995	4,000	6,000		10,000	200	50	10,000	1,000	31,250	1.6	49,129	402	33,470	33,872	83,001	30,366	113,367	0%		30%	27%	57%
1996	400	1,320		10,000	50	100	4,000	450	16,320	1.6	25,657	269	14,483	14,752	40,410	20,848	61,258	0%		24%	34%	58%
1997	350			10,000		100	2,000	150	12,600	1.8	22,627	227	7,933	8,160	30,787	22,408	53,195	0%		15%	42%	57%
1998	3,000	12,530		50,000		50	30,000	2,000	97,580	1.6	153,936	983	27,088	28,071	182,007	107,688	289,695	0%		9%	37%	47%
1999	1,500	1,500		2,000		50	17,000	300	22,350	1.6	35,258	846	31,938	32,784	68,042	20,560	88,602	1%		36%	23%	60%
2000	1,200	1,696		2,000			6,500	300	11,696	1.6	18,561	1,067	6,525	7,592	26,153	4,022	30,175	4%		22%	13%	38%
2001	1,000	870		2,000	104	50	15,000	250	19,274	1.6	30,383	1,617	3,897	5,514	35,897	18,255	54,152	3%		7%	34%	44%
2002				3,000			5,000		8,000	1.8	14,753	132	2,859	2,991	17,744	1,727	19,472	1%		15%	9%	24%
2003				5,000			30,000		35,000	1.8	64,545	318	11,097	11,415	75,960	11,054	87,014	0%		13%	13%	26%
2004	1,500			15,000			12,000	400	28,900	1.7	49,276	1,115	7,338	8,453	57,729	23,878	81,608	1%		9%	29%	40%
2005	300		70	2,000	126		15,000	260	17,756	1.7	30,041	728	2,429	3,157	33,198	8,678	41,876	2%		6%	21%	28%
2006	1,800			15,000	20		13,000		29,820	1.7	51,382	1,214	7,882	9,095	60,478	12,353	72,830	2%		11%	17%	29%
2007				1,000	95		4,900		5,995	1.8	11,005	932	975	1,907	12,911	8,397	21,308	4%		5%	39%	48%
2008				1,000	24		640		1,664	1.8	3,055	511	185	697	3,751	436	4,187	12%		4%	10%	27%
2009	475		51	1,500			9,800	60	11,886	1.7	20,195	447	1,139	1,586	21,781	7,405	29,186	2%		4%	25%	31%
2010	170		68	500			4,200		4,938	1.7	8,515	386	242	628	9,143	1,002	10,146	4%		2%	10%	16%
2011			80	1,170			2,200		3,450	1.8	6,338	245	446	691	7,030	1,387	8,416	3%		5%	16%	25%
2012	113		32	1,100			7,925	56	9,226	1.7	15,676	394	415	809	16,485	2,180	18,664	2%		2%	12%	16%
2013	500	100	20	1,100	NI	AP	7,100	300	9,120	1.6	14,426	243	604	847	15,272	2,262	17,534	1%		3%	13%	18%
2014	419	AP	25	NI	NI	NO	8,200	63	8,707	2.3	20,396	711	422	1,133	21,529	2,789	24,318	3%		2%	11%	16%
2015	1,820	445	91	17,400	NI	NI	6,758	449	26,963	1.6	42,649	1,382	4,050	5,432	48,081	6,924	55,005	3%		7%	13%	22%
2016	902	351	81	3,265	NI	NI	8,139	418	13,126	1.6	20,762	2,923	200	3,124	23,886	4,634	28,520	10%		1%	16%	27%
2017	220	74	AP	7,272	NI	NI	6,804	62	14,432	1.6	22,902	744	60	804	23,707	1,926	25,632	3%		0%	8%	11%
2018	1,828	457	NO	18,686	NI	AP	9,164	AP	30,135	1.6	48,487	535	566	1,101	49,588	3,112	52,700	1%		1%	6%	8%
Averages:																						
1980–1989	1,775	3,565	33	13,200	91	311	4,960	416	24,187	1.6	38,260		27,530	27,530	65,791	39,350	105,141			25%	34%	59%
1990–1999	2,776	4,428	20	18,563	125	73	9,944	644	31,236	2.0	55,511	490	35,010	35,402	90,913	39,550	130,463	0%		27%	30%	57%
2000–2009	1,046	1,283	61	4,750	74	50	11,184	254	16,999	1.7	29,320	808	4,433	5,241	34,560	9,621	44,181	3%		9%	21%	34%
2010–2019	604	273	53	4,254			6,064	217	13,344	1.7	22,239	841	778	1,619	23,858	2,913	26,771	3%		3%	12%	18%

^a Data are from the DFO New Salmon Escapement Database (NuSEDs). AP = adults present; NI = not inspected; NO = none observed.

^b Sum of the annual surveyed indicator stream escapements as documented in NuSEDs.

^c Expansion factor to account for non-surveyed indicator systems, escapement to non-indicator systems, and observer efficiency (1.5) for each year. Method was developed by the Pacific Salmon Foundation (English et al. 2012).

^d Estimated Nass Area escapement (product of observed escapement and expansion factor).

^e Nisga'a catch from annual reports by Nisga'a Fisheries and Wildlife Department (see Mathews et al. 2012) and include release mortality estimates from NJTC (2019).

^f Canadian marine commercial catch is estimated from methods developed by the Pacific Salmon Foundation (English et al. 2012) and include commercial harvests in net fisheries only. 1980 and 1981 are estimated using the average % Nass in commercial catch.

^g US commercial catch is estimated from methods developed by the Pacific Salmon Foundation (English et al. 2012). 1980 and 1981 values estimated using a 25% US ER (1982–1986 average).

Table 12. Summary of 2018 water temperature from surveyed Nass Area streams.

Area	Stream name	Temperature (°C)			
		n	Average	Min	Max
Lower Nass	Ksemamaith Creek	3	10.5	10.0	11.0
	Gitzyon Creek	3	12.8	12.5	13.0
Portland Inlet	Lizard Creek	2	13.0	11.0	15.0
	Crag Creek	3	12.7	11.0	15.0
Portland Canal	Donahue Creek	2	7.5	7.0	8.0
	Dogfish Bay Creek	4	12.2	9.0	15.0
Observatory Inlet	Stagoo Creek	4	8.5	8.0	9.0
	Kitsault River ^a	4	9.0	7.5	10.3
	Illiance River	4	11.0	8.5	12.0
	Wilauks Creek	3	12.7	10.6	14.0
	Kshwan River ^b	3	8.8	7.5	10.0

^a Kitsault River values are for Falls Creek and a mainstem side channel.

^b Kshwan River values are for the surveyed side channels and unnamed tributaries of Kshwan River.

Table 13. Summary of 2018 walk-ability, snorkel-ability, and spawning habitat quality scores for Chum Salmon survey streams in the Nass Area.

Area	Stream name	Walk-ability ^a				Snorkel-ability ^a				Spawning habitat quality ^a			
		n	Average	Min	Max	n	Average	Min	Max	n	Average	Min	Max
Lower Nass	Ksemamaith Creek	3	5	5	5	3	1	1	1	3	3	3	3
	Gitzyon Creek	3	3	3	3	3	1	1	1	3	4	4	4
Portland Inlet	Lizard Creek	0				0				0			
	Crag Creek	1	3	3	3	3	1	1	1	3	3	3	3
Portland Canal	Donahue Creek	1	2	2	2	1	2	2	2	1	3	3	3
	Dogfish Bay Creek	2	5	5	5	3	2	1	2	3	4	3	4
Observatory Inlet	Stagoo Creek	3	4	4	4	2	2	2	2	4	4	3	5
	Illiance River	3	4	4	4	3	2	1	2	3	4	3	4
	Wilauks Creek	2	5	4	5	2	1	1	1	2	4	3	4
	Kitsault River ^b	3	5	5	5	3	2	1	2	3	4	4	4
	Kshwan River ^c	4	4	4	4	4	1	1	1	4	4	2	4

^a 1 = Poor; 2 = Low; 3 = Moderate; 4 = Good; 5 = Excellent.

^b Kitsault River values are for Falls Creek and a mainstem side channel.

^c Kshwan River values are for surveyed side channels and unnamed tributaries.

FIGURES

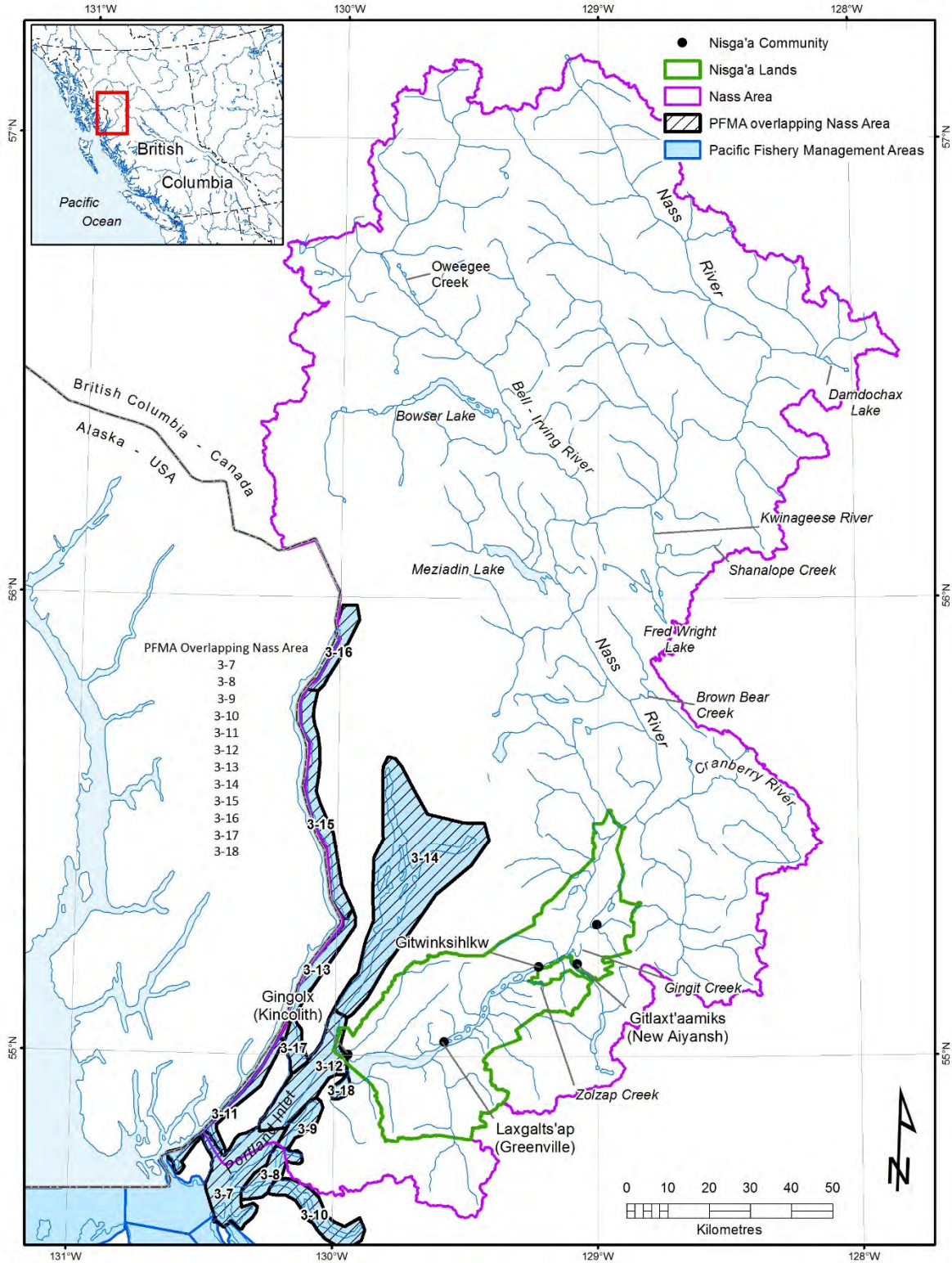
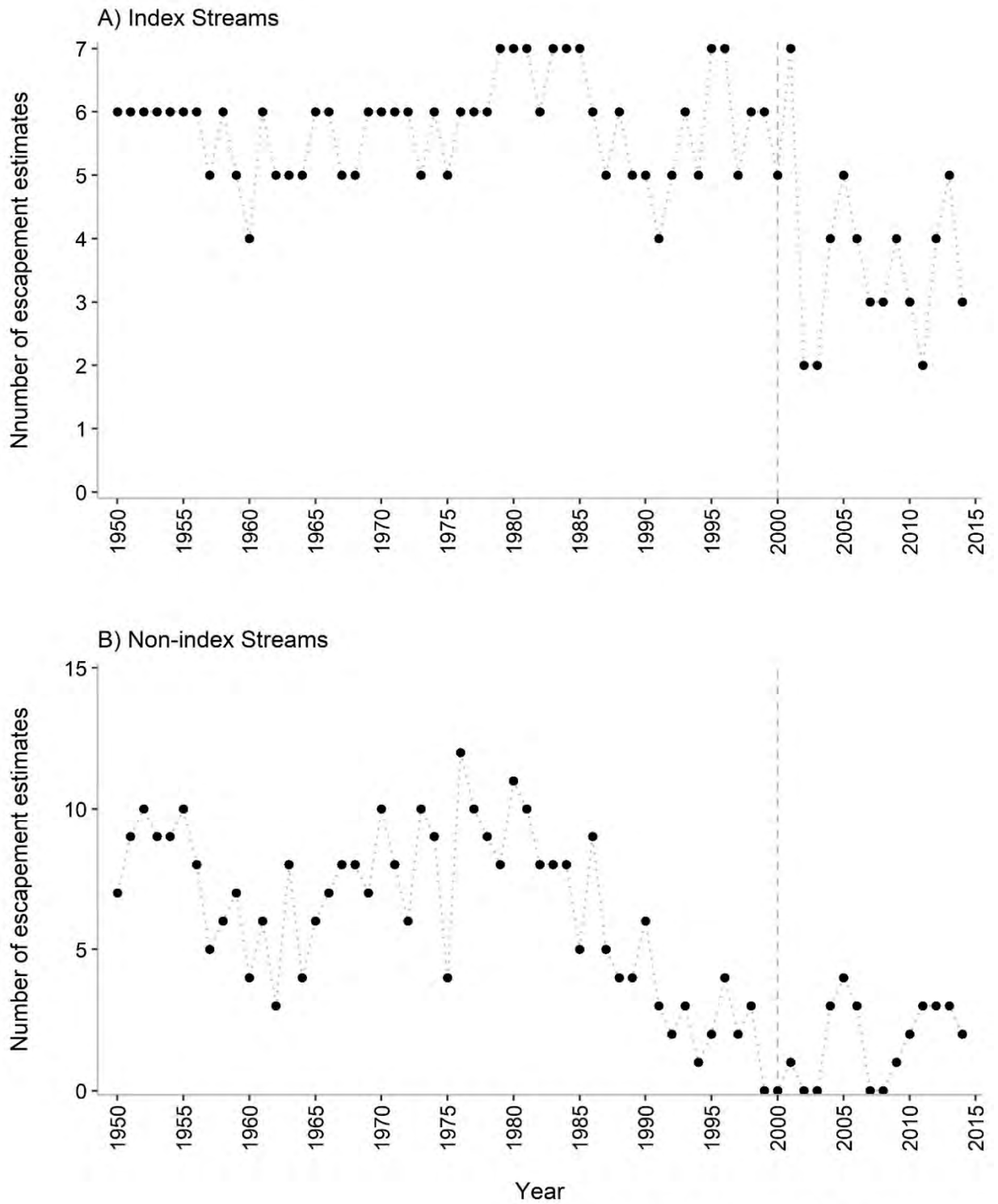


Figure 1. Pacific Fishery Management Area 3 and the Nass Area as defined by the Nisga'a Treaty.



The Nisga'a Treaty was implemented in 2000 (dashed line)

Figure 3. The number of index (A) and non-index (B) streams surveyed by DFO with enough effort to generate escapement estimates, 1950 to 2014.

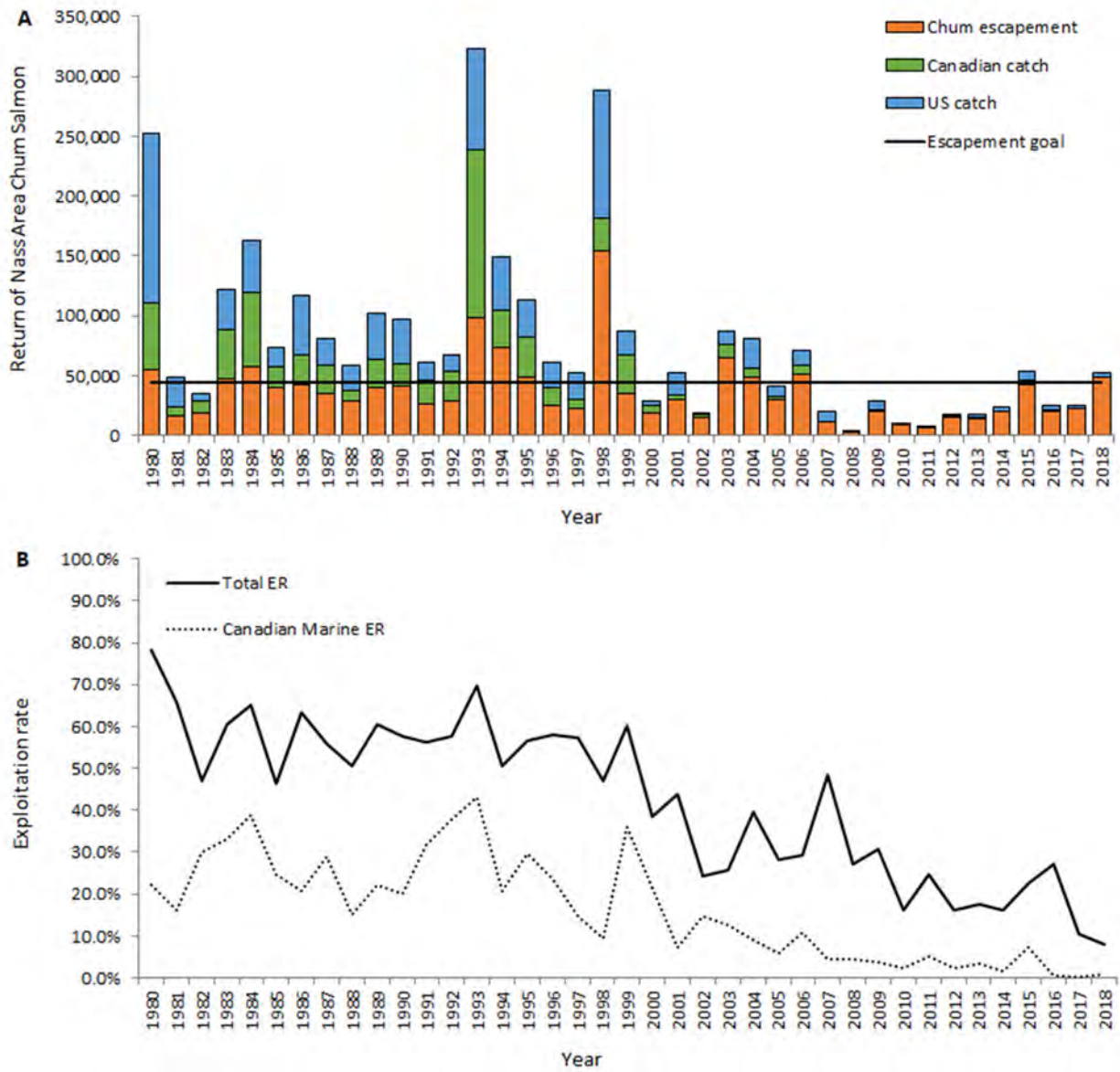


Figure 4. Nass Area Chum Salmon (A) escapement and catch, and (B) exploitation rates from 1980 to 2018. The escapement goal was met in 2018 for the first time since 2006.

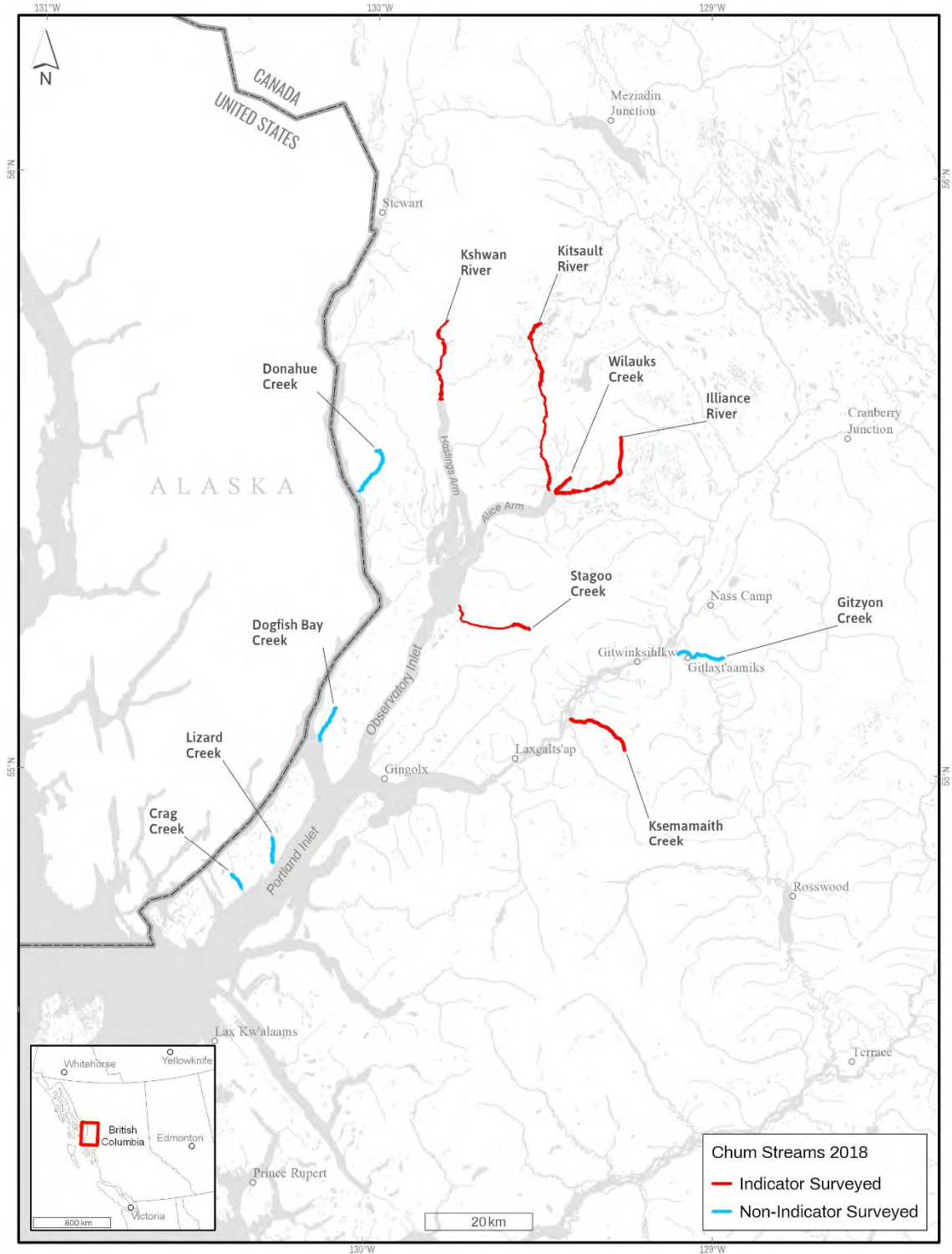


Figure 5. Nass Area Chum Salmon indicator and non-indicator streams surveyed in 2018.



Figure 6. Large beaver dam at the mouth of Tseax side channel in 2017 and 2018.



Figure 7. Ksemamaith Creek Chum Salmon survey reaches, 2018. Surveys end at the logjam.



Figure 8. Gitzyon Creek Chum Salmon survey reaches, 2018.



Figure 9. Dogfish Bay Creek reaches surveyed in 2018.



Figure 10. Donahue Creek Chum Salmon survey reaches, 2018. Surveys end at the start of the canyon section.



Figure 11. Lizard Creek Chum Salmon survey reaches, 2018.

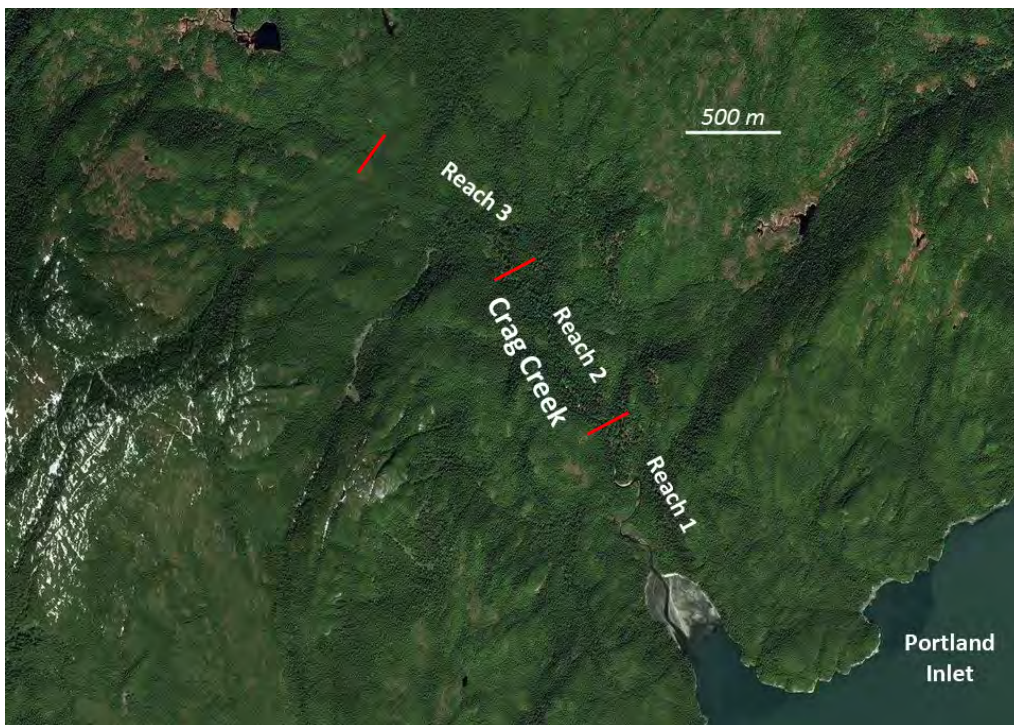


Figure 12. Crag Creek Chum Salmon survey reaches, 2018.



Figure 13. Stago Creek Chum Salmon survey reaches, 2018. Most spawning is observed in reach 3.



Figure 14. Kshwan River Chum Salmon side channel and tributary survey reaches, 2018.



Figure 15. Kitsault River Chum Salmon survey reaches in 2018. Due to access constraints, surveys were limited to Falls Creek and a mainstem side channel.



Figure 16. Illiance River Chum Salmon survey reaches, 2018. Reach 2 of Illiance Creek consists of a large log jam and for safety reasons, it is not counted. Reaches 3 and 4 end at waterfalls.



Figure 17. Wilauks Creek Chum Salmon survey reaches, 2018.

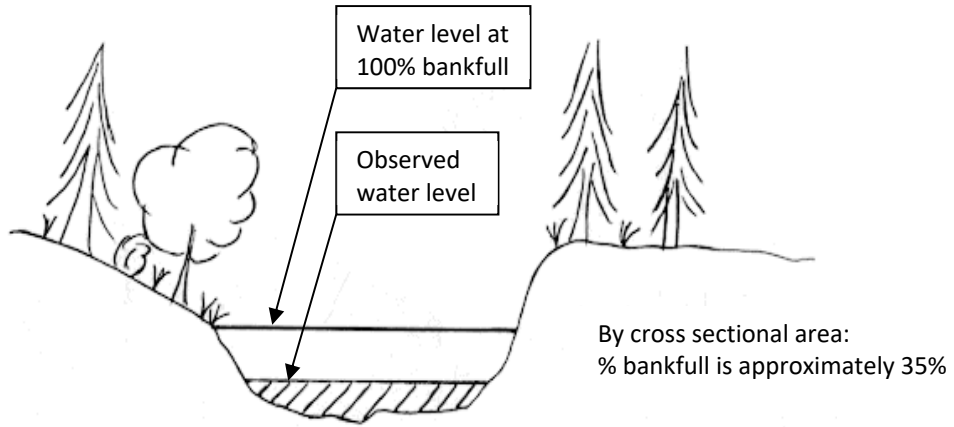
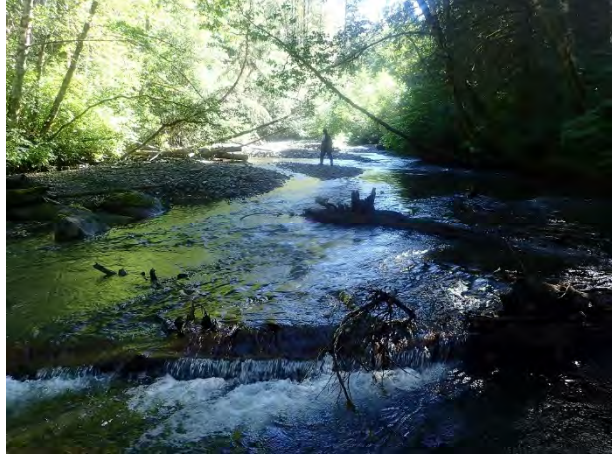


Figure 18. Estimating percent bankfull based on the portion of the channel that is wetted. Figure was copied from DFO Stream Inspection Log definitions.

PHOTOS



A) Reach 1.



B) Reach 2

Photo 1. Typical counting conditions in Ksemamaith Creek in the lower Nass. The channel had changed from 2017, especially in reach 1 (downstream of the highway bridge).

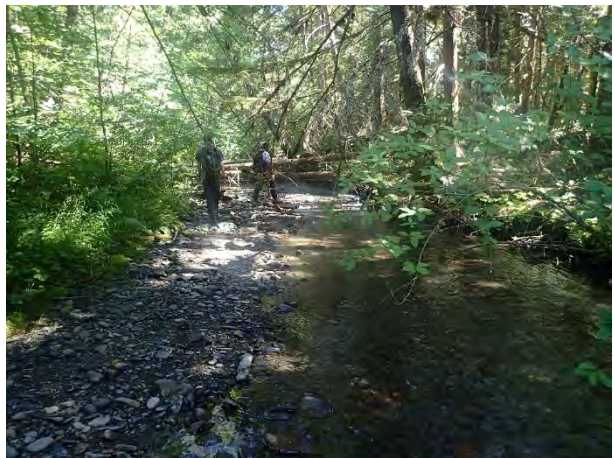
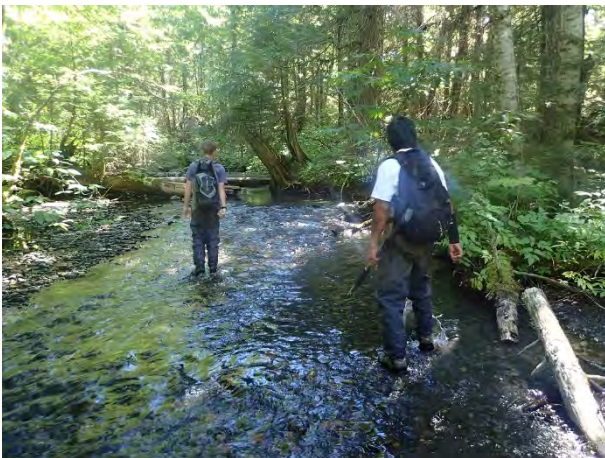


Photo 2. Typical counting conditions in Gitzyon Creek in the lower Nass.



A) Typical counting conditions



B) Canyon section

Photo 3. Representative images of Dogfish Bay Creek showing A) typical counting conditions and B) the canyon section upstream of reach 2.



Photo 4. Representative images of typical counting conditions in Donahue Creek.



Photo 5. Representative images of Lizard Creek on Pearse Island in Portland Inlet. Water in Lizard Creek was tannin stained and tea coloured.



Photo 6. Representative images of typical counting conditions observed in Crag Creek on Pearse Island. Water in Crag Creek was tannin stained and tea coloured.



A) Good counting conditions



B) One of several Chum redds in reach 1



C) Chum spawners in reach 3



D) Chum spawners in reach 6.

Photo 7. Stagoo Creek showing A) counting conditions, B) Chum Salmon redd, and C) and D) Chum Salmon spawners.

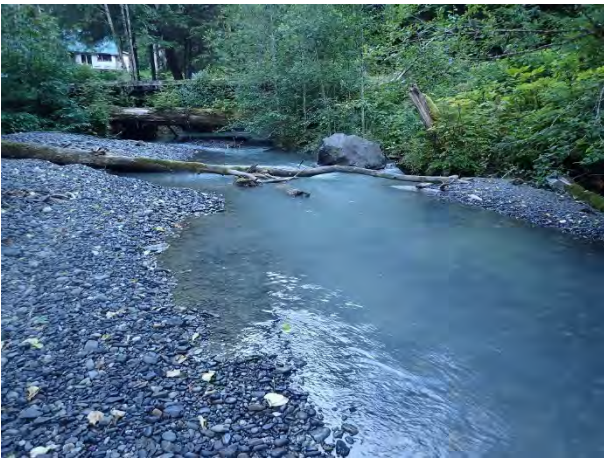


A) Kshwan River side channel



B) Chum spawners and carcasses

Photo 8. Representative images of A) a Kshwan River side channel and B) Chum Salmon spawners and carcasses.



A) Falls Creek



B) Kitsault River side channel

Photo 9. Representative images of A) Falls Creek (Kitsault River tributary) and B) a mainstem Kitsault River side channel.



A) Illiance River



B) Clary Creek



C) Illiance River waterfall.



D) Clary Creek waterfall.

Photo 10. Representative images of A) Illiance River and B) Clary Creek (Illiance tributary). Surveys in both streams end at waterfalls (C & D).



A) Low water on 31 July 2018



B) Thick algae on substrate, 31 July 2018

Photo 11. Representative images of Wilauks Creek, 2018.



Photo 12. Illiance River Chum Salmon carcasses collected for bio-sampling.

APPENDICES

Appendix A – Field forms.

Table A-1. Nisga’a Fisheries and Wildlife Department Chum Salmon stream survey fish count form.

NFWD Chum Stream Survey Form - 2018					Stream Name:				Crew:			Date (dd-mmm):		
Method:		Dead Pitch	Stream Walk	Snorkel	Heli	Other		Air (°C):					Photo Number(s)	Comments
Reach	Start/End Times	Live Count					Carcass Count							
		Chum Tag/NoTag	Pink	Sockeye Tag/NoTag	Chinook Tag/NoTag	Coho Tag/NoTag	Obs. Eff. (%)	Chum No Tag	Chum Tagged	Pink				
Totals														
Comments:														

Table A-2. Nisga’a Fisheries and Wildlife Department water quality, habitat, and countability scoring form.

NFWD Stream Countability - 2018					Stream Name:									Crew:			Date (dd-mmm):	
Reach	Time	% Overcast	Wind	Precip.	Clarity	% Bankfull	Depth (m)	Instream Visibility (m)	Water (°C)	Turbidity (NTU)	DO %	DO mg/L	Walk Score (1-5)	Snorkel Score (1-5)	Habitat Score (1-5)	Photo #	Comments	
			None Light Moderate Strong	None Light Moderate Heavy Very Heavy	Clear Tea Slightly Turbid Muddy Glacial Iced	<25 25-50 50-75 75-100 >100												
			None Light Moderate Strong	None Light Moderate Heavy Very Heavy	Clear Tea Slightly Turbid Muddy Glacial Iced	<25 25-50 50-75 75-100 >100												
			None Light Moderate Strong	None Light Moderate Heavy Very Heavy	Clear Tea Slightly Turbid Muddy Glacial Iced	<25 25-50 50-75 75-100 >100												
			None Light Moderate Strong	None Light Moderate Heavy Very Heavy	Clear Tea Slightly Turbid Muddy Glacial Iced	<25 25-50 50-75 75-100 >100												
			None Light Moderate Strong	None Light Moderate Heavy Very Heavy	Clear Tea Slightly Turbid Muddy Glacial Iced	<25 25-50 50-75 75-100 >100												
			None Light Moderate Strong	None Light Moderate Heavy Very Heavy	Clear Tea Slightly Turbid Muddy Glacial Iced	<25 25-50 50-75 75-100 >100												
Comments:																		

Table A-3. Nisga’a Fisheries and Wildlife Department salmon biosample form.

NFWD Stream Survey - BIOSAMPLE FORM						Year:					Crew:		
Stream Name	Reach	Date (dd-mmm)	Species (circle)	Sex	NF Length (cm)	Tag Type (circle)	Tag # & Colour	Secondary Mark (circle)	Otolith Vial #	Scalebook #	Scale #	Condition	Comments
			CM SK CH CO			None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
			CM SK CH CO			None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
			CM SK CH CO			None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
			CM SK CH CO			None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
			CM SK CH CO			None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
			CM SK CH CO			None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
			CM SK CH CO			None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
			CM SK CH CO			None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
			CM SK CH CO			None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
Comments:													

Appendix B – Score criteria for assessing the walk-ability, snorkel-ability, and spawning habitat quality for Chum Salmon survey streams.

Table B-1. Walk-ability score descriptions.




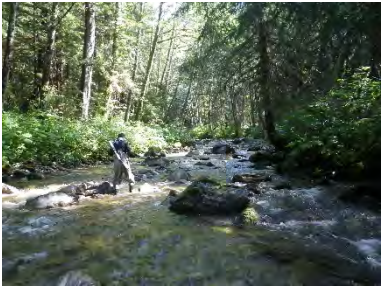

Score	Classification	Description	Example
1	Poor	Extremely difficult or not walkable due to safety concerns (log jams; high flows) or poor accessibility coupled with high flows or turbidity, debris, limited visibility, high confinement or other factors.	
2	Low	Difficult walking due to steep, fast, or deep flow (>1 m); narrow channel with thick vegetation; slippery boulder or bedrock substrate; lots of blowdown; extensive debris jams; poor upstream visibility (<10 m)	
3	Moderate	Average walkability. Mixture of large and small substrate; low-moderate velocity; moderate to good instream visibility; limited blowdown or debris jams; low gradient; safe depth (<1 m); upstream visibility 10–25 m.	
4	Good	Easily walked. Low velocity; good instream visibility; shallow (<50 cm); good traction; limited blowdown or debris jams; stream wide or with little over stream vegetation; good upstream visibility (i.e., 25–50 m)	
5	Excellent	Easily walked. Low velocity; good visibility; good traction; shallow (<50 cm); few hazards; very good upstream visibility (i.e., >50 m)	

Table B-2. Snorkel-ability score descriptions.




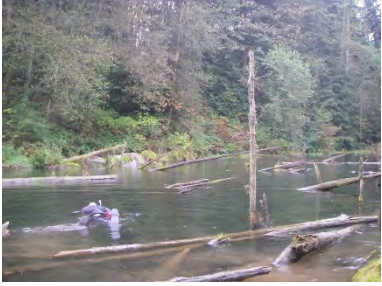
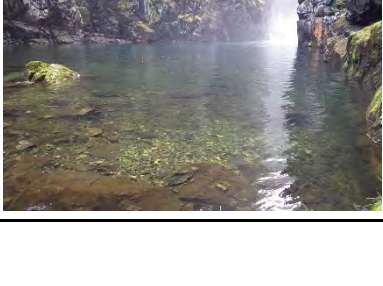


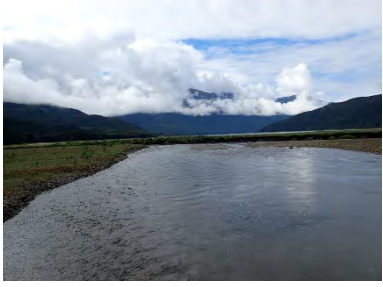


Score	Classification	Description	Example
1	Poor	Snorkelling not possible due to lack of deep pools or glides; extensive debris jams, lack of safe egress; high turbidity or velocity prevent safe or effective snorkelling.	
2	Low	Snorkelling difficult due to lack of suitable habitat. Pools and glides are infrequent and small; limited visibility; moderate–high velocity. Difficult to identify potential hazards such as extensive debris jams, turbulent water, lack of egress.	
3	Moderate	Sufficient depth for snorkelling. Flow velocity is safe and manageable. Hazards easily identified before snorkelling. Moderate to good visibility.	
4	Good	Slow and clear pools, glides, or offchannel areas. Some potential hazards (e.g., woody debris; boulders). Good visibility.	
5	Excellent	Slow, clear pools, glides, or offchannel habitat with no hazards. Visibility is very high.	

Table B-3. Chum Salmon spawning habitat quality score description.

Score	Classification	Description	Example
1	Poor	Gradient >3%; cobbles and boulders dominate substrate; flows dominated by cascades; no pools.	
2	Low	Gradient about 3%; few patches of suitable spawning gravel; few pools or riffles; shallow flow.	
3	Moderate	Gradient <3%; good patches of suitable gravel; frequent pools and riffles; good flow and depth >10 cm.	
4	Good	Gradient ≤1%; depth >10 cm; frequent suitable gravels; frequent pools and riffles.	
5	Excellent	Gradient ≤1%; depth >10 cm; abundant suitable gravels and flow conditions.	

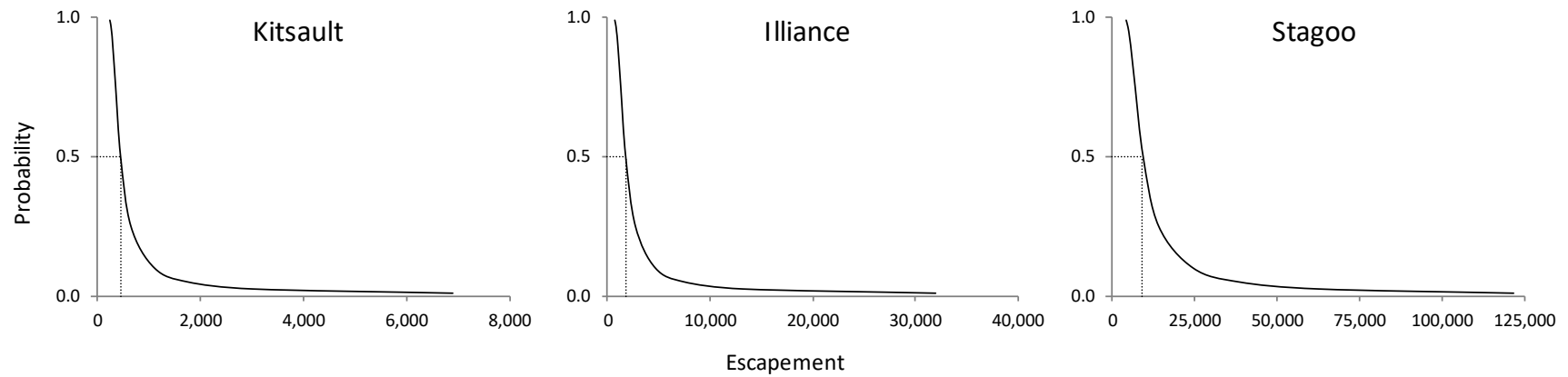
Appendix C– Probability distributions of Chum Salmon AUC escapement estimates.

Figure C-1. Probability distributions of AUC escapement estimates for Nass Area Chum Salmon streams surveyed in 2018. Probability distributions were generated using AUCmonteMASTER 2.04 and the dashed lines show the escapement estimate for each stream.

Appendix D – Fisheries and Oceans Canada escapement estimate classification.

Table D-1. Fisheries and Oceans Canada classification system for Pacific salmon escapement estimate quality.

Escapement estimate class	Estimate quality	Description
1	High	An estimate of high resolution from an unbreached fence count. The estimate uncertainty is believed to be less than plus or minus 10% of the actual estimate.
2	High	An estimate of high resolution based on documented measured data.
3	High	An estimate of high resolution based on three or more documented inspections of walking, floating, or flying which clearly define the peak of spawning and contain high adult live estimates with high fish countabilities; Or an estimate of medium resolution based on documented data from a Mark & Recapture, Fixed Site method, or medium to high AUC calculation. The estimate uncertainty is believed to be less than plus or minus 25% of the actual estimate.
4	Medium	An estimate of medium resolution based on the documentation of two or more walking, floating, or flying inspections around the peak of spawning containing high adult live estimates with high fish countabilities; Or possibly low reliable fence count records, Mark & Recapture data or low to medium AUC calculation. The estimate uncertainty is believed to be no better than plus or minus 25% of the actual estimate.
5	Low	Low resolution.
6	No Estimate	None Observed (NO); Adults Present (AP); Not Inspected (NI); Do Not Spawn (DNS); Fry Present (FP).

Appendix E – Counts and escapement estimates for Pink and Sockeye salmon.

Table E-1. Pink and Sockeye salmon counts for each Nass Area stream surveyed in 2018.

Survey					Pink			Sockeye			Comment
Area	Stream name	Date	Length (m)	Observer efficiency	Expanded			Expanded			
					Raw live	live	Carcass	Raw live	live	Carcass	
Lower Nass	Ksemamaith Creek	04-Aug-2018	700	90%	0	0	0	0	0	0	
		15-Aug-2018	700	90%	0	0	0	0	0	0	
		07-Sep-2018	700	90%	36	40	0	0	0	0	
	Gitzyon Creek	04-Aug-2018	1,500	80%	0	0	0	220	244	11	
		15-Aug-2018	1,500	95%	0	0	0	106	133	80	
		25-Aug-2018	1,000	80%	0	0	0	3	4	0	
Portland Inlet	Crag Creek	23-Aug-2018	500	100%	0	0	0	0	0	0	
		03-Sep-2018	3,000	80%	8	11	0	0	0	1	Sockeye carcass was in a pool at the top of the estuary
		14-Sep-2018	3,000	95%	112	118	0	0	0	0	
	Lizard Creek	23-Aug-2018	2,000	90%	1	0	0	0	0	0	
		03-Sep-2018	1,500	60%	0	0	0	0	0	0	
		15-Sep-2018	0								
Portland Canal	Donahue Creek	09-Aug-2018	0								
		22-Aug-2018	0								
		01-Sep-2018	800	70%	132	189	21	0	0	0	
	Dogfish Bay Creek	13-Sep-2018	800	90%	27	30	36	0	0	0	
		09-Aug-2018	1,400	90%	105	117	0	0	0	0	
		22-Aug-2018	1,400	95%	1,005	1,015	8	0	0	0	
Observatory Inlet	Stagoo Creek	01-Sep-2018	800	80%	3,718	4,648	128	0	0	0	
		13-Sep-2018	1,400	90%	633	703	532	0	0	0	
		15-Jul-2018	2,000	68%	0	0	0	0	0	0	
		29-Jul-2018	3,200	71%	12	16	0	0	0	0	
		08-Aug-2018	4,500	90%	3,258	3,620	0	0	0	0	
		20-Aug-2018	4,500	58%	2,793	3,563	149	0	0	0	
		29-Aug-2018	0								

Table E-1 continued.

Survey				Pink			Sockeye			Comment		
Area	Stream name	Date	Length (m)	Observer efficiency	Raw live	Expanded live	Carcass	Raw live	Expanded live		Carcass	
Observatory Inlet	Kitsault River ^a	31-Jul-2018	100	60%	0	0	0	0	0	0		
		07-Aug-2018	900	90%	3	3	0	0	0	0		
		16-Aug-2018	900	100%	202	202	5	0	0	0		
		28-Aug-2018	0								Flood conditions prevented survey	
		12-Sep-2018	900	93%	709	776	332	1	1	0		
	Illiance River	30-Jul-2018	1,800	72%	330	550	0	0	0	0		
		06-Aug-2018	1,800	86%	9,500	11,176	0	0	0	0		
		17-Aug-2018	1,800	83%	5,888	7,698	19	0	0	0		
		28-Aug-2018	0								Flood conditions prevented survey	
	Kshwan River	12-Sep-2018	1,800	79%	2,116	2,721	1,354	3	4	1	Sockeye were observed in Clary Creek (Illiance tributary)	
		Wilauks Creek	30-Jul-2018	1,000	95%	0	0	0	0	0	0	
			06-Aug-2018	1,900	90%	0	0	0	0	0	0	
			17-Aug-2018	1,700	100%	4	4	0	0	0	0	
		28-Aug-2018	0								Flood conditions prevented survey	
		18-Aug-2018	800	100%	70	70	0	0	0	0		
19-Aug-2018		3800	75%	447	824	13	0	0	0			
27-Aug-2018		1100	95%	42	47	0	0	0	0			
28-Aug-2018		0								Flood conditions prevented survey		
10-Sep-2018	1100	87%	17	28	1	0	0	0				
11-Sep-2018	3800	79%	1,084	1,400	283	1	1	0				
27-Sep-2018	0								Poor marine conditions prevented crew access			
28-Sep-2018	0											

^aKitsault River surveys included a mainstem sidechannel and the first 100m of Falls Creek (survey ends at a waterfall).

Table E-2. Best escapement estimates for Pink and Sockeye salmon runs observed during surveys in the Nass Area, 2018.

Area	Stream name	Escapement estimates ^a			
		Pink		Sockeye	
		AUC ^b	Peak count x 2 ^c	AUC ^d	Peak count x 2 ^c
Lower Nass	Ksemamaith Creek	-	AP	-	NO
	Gitzyon Creek	-	NO	420	510
Portland Inlet	Lizard Creek	-	AP	-	NO
	Crag Creek	-	236	-	NO
Portland Canal	Donahue Creek	-	420	-	NO
	Dogfish Bay Creek	-	9,552	-	NO
Observatory Inlet	Stagoo Creek	6,763	7,424	-	NO
	Kitsault River ^e	1,507	2,216	-	AP
	Illiance River	24,095	22,352	-	AP
	Wilauks Creek	-	AP	-	NO
	Kshwan River ^f	-	3,424	-	AP

^a AP = Adults present; NO = None observed.

^b Residence time (RT) and standard deviation (SD) for Pink Salmon estimates: RT = 12.6 d; SD = 4.0 d.

^c Estimate is based on the observation that peak counts can underestimate weir counts by 30 to 50% (Cousens et al. 1982).

^d Residence time for Gingit Creek Sockeye Salmon used for Gitzyon Creek (both sea-type stocks): RT = 13.1 days, SD = 2.0 days (NFWD 2019).

^e Kitsault River estimates are based on counts from Falls Creek and a mainstem side channel.

^f Kshwan River estimates are based on counts from side channels and unnamed tributaries of Kshwan River.



Photo E-1. Sockeye Salmon observed in Clary Creek (Illiance River tributary) on 12 September 2018. This was the first year NFWD crews observed Sockeye Salmon in the Illiance River system.