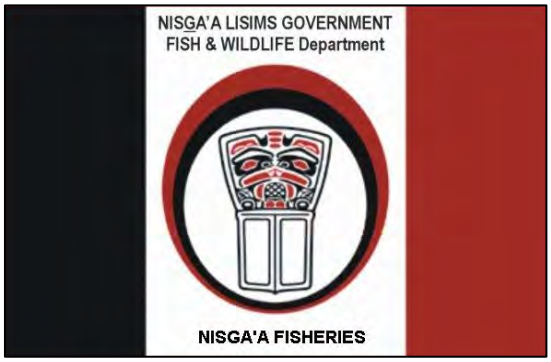

Chum Salmon (*Oncorhynchus keta*) Escapement Surveys in Area 3 and the Nass Area, 2023

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Nisg̲a'a Fisheries Report #23-26

July 31, 2024

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CHUM SALMON (*Oncorhynchus keta*) ESCAPEMENT SURVEYS IN AREA 3 AND THE NASS AREA, 2023

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July 31, 2024

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOS

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

The following acronyms and abbreviations are used in this Nisg̲a'a Fisheries report:

AUC	area-under-the-curve
BC	British Columbia
DFO	Fisheries and Oceans Canada
EF	expansion factor
ER	exploitation rate
NFL	nose-fork length
NFWD	Nisg̲a'a Fisheries and Wildlife Department
NJTC	Nisg̲a'a-Canada-BC Joint Technical Committee
NuSEDS	New Salmon Escapement Database System
OE	observer efficiency
PFMA	Pacific Fishery Management Area
PSC	Pacific Salmon Commission
RT	residence time
SD	standard deviation
US	United States

EXECUTIVE SUMMARY

Beveridge, I. A., R. F. Alexander, C. A. J. Noble, S. C. Kingshott, and T. Angus. 2024. Chum Salmon (*Oncorhynchus keta*) escapement surveys in Area 3 and the Nass Area, 2023. Prepared for the Pacific Salmon Commission (NF-2023-I-16), Vancouver, BC, and the Nisga'a-Canada-BC Treaty Fisheries Management Committee, Gitlaxt'aamiks and Prince Rupert, BC, by LGL Limited, Sidney, BC, and the Nisga'a Fisheries and Wildlife Department, Gitlaxt'aamiks, BC. Nisga'a Fisheries Report #23-26: v + 49 p.

Funding ($73,400) received from the Pacific Salmon Commission's Northern Fund ($58,000), Fisheries and Oceans Canada ($4,000 in aerial support), LGL Limited ($9,900 in staffing) and Nisga'a Lisims Government ($1,500 in staffing and vessel use) in 2023 enabled LGL Limited biologists and the staff of the Nisga'a Lisims Government Fisheries and Wildlife Department (NFWD) to successfully conduct escapement ground surveys for Chum Salmon (*Oncorhynchus keta*) in the Nass Area (Pacific Fishery Management Area 3) and compute high quality total run size estimates that contributed to a multi-year research project that started in 2014 (Beveridge and Alexander 2015).

A total of six remote coastal systems, including five indicator (Ksi Kswan [Kshwan River], Ksi Xts'at'kw [Stagoo Creek], Illiance River, Wilauks Creek, and Dak River [Kitsault River tributary]) and one non-indicator (Ksi Xmaat'in [Dogfish Creek]) streams in Area 3, were inspected between 21 July and 19 September 2023 in Observatory Inlet (five streams) and Portland Canal (one stream). In the lower Nass River, we also inspected Ksemamaith Creek (indicator stream) and Gitzyon Creek. At least four surveys spanning the peak count were planned for each indicator system. We conducted a total of 17 stream surveys for Chum Salmon (and Pink Salmon [*O. gorbuscha*]) in 2023, 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 2023. The highest Chum Salmon escapements were observed in Ksi Kswan (Kshwan River; 23,624) and Ksi Xts'at'kw (Stagoo Creek; 7,088) accounted for 98% of the observed Nass Area indicator escapement (31,400). The estimate to Illiance River (641) was about half the average escapement since 1994. The total estimated escapement for the Nass Area in 2023 was 54,147 Chum Salmon and was over the escapement goal (45,000). The 2023 aggregate escapement estimate, while lower than recent years, continues a recent trend of improved Chum Salmon escapement to coastal streams in the Nass Area. In addition, the 2023 return also represented good returns of both summer (Ksi Xts'at'kw [Stagoo Creek]) and fall (Ksi Kswan [Kshwan River]) timed Chum Salmon returning to Area 3.

The estimated total return to Canada and total run size of Nass Area Chum Salmon in 2023 was 54,905 and 64,897, respectively. The estimated exploitation rate (i.e., total harvest of total return) of Nass Area Chum Salmon fisheries was 16.6% (0.1% Nisga'a; 1.2% Canadian; and 15.3% US) and was below average (24.1%; range: 8.0–48.4%) based on total returns from 2000 to 2023. The study also collected 263 otolith samples from Ksi Kswan [Kshwan River]. None of the samples were identified as hatchery origin.

INTRODUCTION

Chum Salmon (*Oncorhynchus keta*) stocks in the Nass Area[1] (Figure 1; Figure 2) are depressed, with escapement below the provisional escapement target (45,000) in 15 of the past 23 years (2000–2022; Table 1; Figure 3A; Beveridge and Alexander 2015; Beveridge et al. 2016−2020; Noble et al. 2021; Beveridge et al. 2022−2023; Nisga'a-Canada-BC Joint Technical Committee [NJTC] 2024). From 2007 to 2022, the estimated total run for Nass Area Chum Salmon returned on average 56% (57,000 fish) lower than the average return from 1980 to 2006 (45,000 vs. 102,000) and only met the escapement goal in five years (2015, 2018, 2020, 2021, and 2022) of the past 16 years. The long history of poor returns in more terminal areas of the Nass marine areas of Area 3 is surprising as the available spawning habitat was found to be excellent (Gaboury and Bocking 2007) and relatively low harvest rates have occurred since 2007. In response to poor returns since 2007, Fisheries and Oceans Canada (DFO) resource managers, with support from the Nisga'a Lisims Government Fisheries and Wildlife Department (NFWD) and LGL Limited, have reduced Canadian marine exploitation rates to a mean of 2.4% (range: 0.0−7.4%) from 2007 to 2022 compared to the 1980 to 2006 mean of 22.3% (range: 5.8−39.4%; Table 2; Figure 3B). Exploitation rates of Nass Area Chum Salmon in Alaskan fisheries are estimated to have also substantially declined since 2007 to a mean of 15.2% (range: 5.8−39.4%) from 28.8% (range: 8.9−56.0%) from 1980 to 2006 (NJTC 2024), likely a result of low abundance and timing factors of Chum Salmon returning to the Nass Area. As a result, on average the US fishery is estimated to be harvesting 25,000 (78%) fewer Nass Area Chum Salmon than the average harvest from 1980 to 2006 (7,000 vs. 32,000). However, the accuracy of Nass Area Chum Salmon stock contributions in all marine fisheries are highly uncertain and we hope that future development of genetic stock identification or other stock composition methods will help refine and confirm stock interceptions.

While recovery of Nass Area Chum Salmon stocks has not fully occurred to date based on not reaching the aggregate escapement goal each year, there are positive indications that stock abundances are improving. The 2015, 2018, 2020, 2021, and 2022 Nass Area escapements were the highest observed since 2006. Starting in 2015, the NFWD commenced standardized surveys on coastal Area 3 Chum Salmon indicator streams to improve the data defining the decline in these stocks following the review of Beveridge and Alexander (2015) in 2014. Effective management of Nass Area Chum Salmon and development of a recovery plan for DFO's Wild Salmon Policy (DFO 2009) requires accurate escapement and run size data. Consistent survey effort and higher quality estimates are necessary and are the focus of NFWD's salmon escapement surveys. High quality estimates are essential to understand the status of current Nass Area Chum Salmon returns and to monitor population trends in the future. To achieve high quality estimates for all surveyed streams, our goal is to continue collecting escapement data using standardized methods.

[1] The Nass Area, as defined in the Nisga'a Final Agreement, includes the Nass River watershed, all Canadian watersheds that drain into portions of Portland Inlet, Portland Canal, and Observatory Inlet, and marine waters in Pearse Canal, Portland Inlet, Portland Canal, and Observatory Inlet (see Figure 1).

Objectives

Fisheries and Oceans Canada's Wild Salmon Policy has identified 36 Chum Salmon spawning streams from three conservation units (CU) in Pacific Fishery Management Statistical Area 3 (Lower Nass CU; Portland Inlet CU; Portland Canal-Observatory Inlet CU) 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 (seven coastal and one lower Nass) indicator systems (22% of identified Chum Salmon streams) from these conservation units (Figure 2; English et al. 2019).

Escapement surveys in 2023 represent the 10th year of the Pacific Salmon Commission (PSC) Northern Fund funding support of a multi-year project with NFWD, LGL Limited, and DFO to standardize Chum Salmon escapements to Nass Area coastal and lower Nass streams and to develop a long-term, scientifically defensible, and cost-effective escapement program. The primary goal of the 2023 project was to conduct stream surveys and collect escapement data for Nass Area Chum Salmon following a standardized methodology to improve the quality of estimates while having adequate funding support for helicopter use to access very remote systems in the Nass Area.

Specific objectives for 2023 were:

1. Generate escapement index counts for up to six Chum Salmon indicator streams, five in Nass Area coastal marine systems of Area 3 (Ksi Kswan [Kshwan River], Ksi Xts'at'kw' [Stagoo Creek], Kitsault River [including Dak River], Illiance River, and Wilauks Creek) and one lower Nass Chum Salmon CU indicator system (Ksemamaith Creek). We propose, weather depending, to survey each stream a minimum of four times during the 2023 spawning period to bracket arrival timing and peak spawning,
2. Generate aggregate Nass Area Chum Salmon escapement estimates for 2023 and present results in a technical report, and
3. Opportunistically collect otolith samples from Chum Salmon from indicator streams walked for analyses of potential hatchery origin from Alaska and stock composition for contributing to regional stock baselines. Sufficient samples will be collected for providing to both ADFG and DFO's labs.

This report summarises our 2023 data collection and provides recommendations for future Nass Area Chum Salmon escapement surveys.

METHODS

Surveyed Streams

Six coastal Nass Area streams were surveyed for Chum Salmon escapement in 2023 by NFWD, including five indicator and one non-indicator (Dogfish Creek) streams in coastal marine areas of Area 3 (Figure 4). We also surveyed Ksemamaith Creek (lower Nass indictor system) and Gitzyon Creek (non-indicator).

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, they were not

assessed due to the challenges in counting the low numbers of Chum Salmon (Figure 5) that return each year to these large systems.

Specific streams surveyed in 2023 were:

Observatory Inlet (Area 3-14):

1. Ksi Xts'at'kw (Stagoo Creek; indicator stream; Figure 6; Photo 1)
2. Ksi Kswan (Kshwan River; indicator stream; Figure 7; Photo 2). Surveys were conducted in:
    a. mainstem side-channels
    b. unnamed tributaries
3. Illiance River (indicator stream; Figure 8; Photo 3)
4. Wilauks Creek (indicator stream; Figure 9; Photo 4)
5. Dak River (Kitsault River tributary; indicator stream; Figure 10; Photo 5).

Portland Canal (Area 3-17):

1. Ksi Xmaat'in (Dogfish Creek; non-indicator stream; Figure 11; Photo 6).

Lower Nass:

1. Ksemamaith Creek (indicator stream; Figure 12; Photo 7)
2. Gitzyon Creek (non-indicator; Figure 13; Photo 8).

At least four ground surveys (stream walks) spanning the peak count were planned for each system weather depending. Surveys started with Ksi Xts'at'kw (Stagoo Creek) on 21 July and ended with Ksi Kswan (Kshwan River) on 19 September. The primary access method for coastal Nass Area systems in 2023 was helicopter but boats were used for access to Ksi Xmaat'in (Dogfish Creek) each survey (Table 3). All fish count and habitat data were recorded on NFWD 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 (e.g., Pink Salmon) were also recorded. The lead counter estimated their observer efficiency (OE; %), 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 water temperature and percent bank full data, and sampled (i.e., measured length; identified sex; collected scales and otoliths) select intact carcasses (Table A-2).

Percent Bank full

The percent bank full, 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 were full and then estimating the percentage of the cross-sectional area that was fully wetted (Figure 14). Estimates of percent bank full were grouped into five categories: <25%, 25−50%, 50−75%, 75−100%, and >100%.

Otolith Collection

In 2023, LGL Limited and NFWD collaborated with North Coast DFO (Jessica Ottley, Tyler Winther) to collect otolith and tissue samples from Chum Salmon in Ksi Kswan (Kshwan

River). Alaskan hatchery Chum Salmon are thermally marked, and their hatchery of origin can be determined by examining their otoliths. Hatchery Chum Salmon are known to stray (e.g., 3 Alaskan hatchery Chum Salmon were found by NFWD in Crag Creek on Pearse Island in 2015). The extent of straying by hatchery fish to streams in the coastal Nass Area has not been studied and this collaboration provided an excellent opportunity to collect these data. Our target was 300 samples.

Escapement Estimation

Escapement was estimated using peak count times two (Cousens et al. 1982) and area-under-the-curve (AUC) methodology (Perrin and Irvine 1990; English et al. 1992). Spawner counts should span the spawning peak and include live counts from three or more surveys to achieve a high-quality estimate as defined by DFO's Pacific salmon escapement estimate quality classification system (Table B-1). The peak count times two estimate is calculated as the peak live count times two plus the cumulative carcasses counted to the peak date.

The AUC method 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 (Perrin and Irvine 1990). Confidence bounded escapement estimates for Chum Salmon are calculated using the Microsoft Excel program AUCmonteMASTER 2.04 (algorithms were developed by DFO [Prince Rupert]). This program uses Monte Carlo simulation (10,000 iterations) of variation in OE and residence time to develop a frequency distribution of escapement values. The midpoint of the frequency distribution is selected as the escapement point estimate (e.g., Figure C-1).

Variation in residence time is modelled as normal and OE is modelled on a per-survey basis. Crew estimates of reach-specific OE are first filtered to remove low values (i.e., < 50%), where we assume that if viewing conditions were so poor that the crew estimated that they could only see a small proportion of the fish, then conditions were also too poor to accurately estimate that proportion.

The estimated survey-specific value of OE is calculated as the average of the reach specific estimates, weighted by the estimated total number of live salmon in each reach. This in turn is calculated by dividing the raw live count for each reach by the estimated OE for that reach. Therefore, if *r* = reach specific raw count, *o* = estimated reach specific OE, and n = the number of reaches, estimated survey-specific OE is:

$$\sum_{i=1}^{n} r_i \; / \sum_{i=1}^{n} (r_i \; / o_i).$$

As OE is derived from crew estimates rather than measured values, variation in OE is modelled as uniform. For estimated observer efficiencies between 75% and 100%, the maximum value is set as 100% and the minimum value is the estimated OE minus the difference between 100% and the estimated OE. For estimated observer efficiencies between 50% and 75%, the maximum and minimum values of OE are set as the estimated OE ± 25%.

RESULTS AND DISCUSSION

Streams Surveys

Access

Two to four stream walks or aerial counts were conducted on each Nass Area stream to count Chum Salmon and other salmon species present with challenging weather experienced in 2023 (Table 4; Figure 4). We utilized a helicopter to access all coastal indicator streams and a boat for access to more local, non-indicator streams (e.g., Ksi Xmaat'in (Dogfish Creek)). Helicopter funding in 2023 represented a high proportion (46% [($31,500 including tax]) of the total funds ($67,600) available to support the escapement surveys on these very remote systems with PSC Northern fund providing most of the funds ($27,400) followed by DFO ($4,000). Helicopter access offered several advantages over marine vessels used in past years and improved our sampling program in several ways. First, it allowed crews to survey streams more efficiently and to survey more streams in a single day. Where our surveys of Ksi Xts'at'kw (Stagoo Creek) and Alice Arm streams (Illiance, Wilauks, Kitsault/Dak) in DFO Statistical Area 3-14 typically took two to three days via marine vessel, we can now survey these systems in a single day via helicopter. Finally, the flexibility of scheduling the helicopter allowed us to respond to poor weather and/or sampling conditions (e.g., prolonged rain) by adjusting survey days to more appropriate times.

A total of seven helicopter (21 July; 7, 17, 26, 27 August; 8, 19 September) and two boat (10, 23 August) surveys were conducted in 2023. Of the total aerial and boat surveys, 16 stream counts were conducted from 21 July to 19 September.

Chum Salmon Escapement Estimates

Chum Salmon were observed in every stream surveyed, including in Ksi Xmaat'in (Dogfish Creek). In previous years, very few Chum Salmon spawners have been observed in this stream. It is primarily a Pink (*O. gorbuscha*) and Coho (*O. kisutch*) salmon system. The highest Chum Salmon counts observed in a single day were in Ksi Kswan (Kshwan River; 8,697 live plus 692 carcasses; Table 6) on 8 September and Ksi Xts'at'kw (Stagoo Creek; 4,403 live plus 169 carcasses; Table 4; Table 5) on 7 August. Escapement to these two streams alone account for approximately 98% of the total estimated escapement to indicator streams (31,400), and 28% of the total estimated 2023 Nass Area escapement (54,147). Below average numbers were observed in Wilauks Creek (18; Table 7) and Illiance River (641; Table 8), respectively. High turbid flows prevented us from conducting ground surveys of Dak River on 17 August and only 15 Chum Salmon were estimated on 26 August (Table 9).

In the lower Nass River, no Chum Salmon were observed in Gityzon Creek, but we estimated 47 spawners in Ksemamaith Creek. A total of 222 were captured at the Nass fishwheels that operated from 1 June to 6 September and was above average (222 vs. 121) when comparing fishwheel operations from 2000 to 2023 (NFWD 2024).

We calculated AUC escapement estimates for three of the five surveyed indicator streams. We did not have sufficient counts for an AUC estimate of Dak River or Wilauks Creek (Table 11). The best escapement estimates for each surveyed indicator system were submitted to DFO for entry into the New Salmon Escapement Database System (NuSEDS; Table 5 to Table 9). The

escapement estimates generated in 2023 were classified according to DFO's escapement quality classifications (Table B-1) with three systems (Ksi Xts'at'kw [Stagoo Creek], Ksi Kswan [Kshwan River], and Illiance River) classified as a high-quality escapement estimate, and one system (Ksemamaith Creek) classified as having a low-resolution estimate. While low numbers of Chum Salmon were observed in Dak River (15) and Wilauks Creek (18), the escapement was set as 'Adults Present' due to the low counts. These estimates were used in the Pacific Salmon Foundation method (English et al. 2019) to estimate the total Chum Salmon return to the Nass Area (Table 1; NJTC 2024). The estimated Nass Area Chum Salmon escapement (54,147) was 120% of the escapement goal (45,000; Figure 3; Table 1).

Achieving the escapement goal for Nass Area Chum Salmon in recent years (2015, 2018, 2020, 2021, 2022, and 2023) is a positive sign, but the stocks are not yet recovered and consistently above the aggregate escapement goal (45,000). Commercial harvests of Chum Salmon in Area 3 are also starting to occur again. In 2023, one gillnet (14 July) and four commercial seine fisheries occurred in Area 3 (10, 11, 17, and 18 July) where 51,569 Chum Salmon (and 262,102 Pink Salmon) were harvested. The Nass Area stock composition was estimated small (758 or 1.2% exploitation rate) but methods of stock identification for Chum Salmon are highly uncertain. Commercial Chum Salmon harvests in Area 3 from 2000 to 2023 averaged 47,000 (range: 0–166,500) fish with Nass Area stocks averaging only 2,300 (range: 0–11,000) fish with low exploitation rates (average 5.1% [range: <1–21.6%). Continuing to reduce commercial harvests of Chum Salmon in Area 3 until the escapement goal is regularly met appears to be the best cost-efficient recovery action to consider in the future.

Nisga'a Lisims Government (NLG) remains committed to advancing recovery efforts of Nass Area Chum Salmon especially in context of implementing the fisheries provisions in the Nisga'a Treaty (NFA 1999) that came into effect in 2000. The Nisga'a Treaty entitlement of Nass Area Chum Salmon was negotiated with Canada and expected to range annually from 2,400 to 12,000 based on small (30,000) and large (150,000) total returns to Canada (8%). Due to low returns of Nass Area Chum Salmon and many years of not meeting the escapement goal, the Nisga'a fisheries has only harvested on average less than 700 (range: 19–3,000) Chum Salmon from 2000 to 2023 or 14% of the total Nisga'a entitlement (119,000) of Nass Area Chum since 2000. NLG continues to advocate for limited fishery opportunities in Area 3 and have foregone most of the Nisga'a entitlement of Nass Area Chum Salmon since 2000 (~66,000) for promoting stock recovery until returns are consistently reaching their escapement goal each year to sustain future returns and have stable production to support commercial, Nisga'a Treaty, and other indigenous fishing opportunities.

Other Salmon Counts and Escapement Estimates

In addition to Chum, Pink Salmon were observed during our surveys (Table C-1). Pink Salmon were observed in all surveyed streams, although their estimated numbers varied greatly from 8,505 fish (Wilauks Creek) to over 250,000 fish (Ksi Xmaat'in [Dogfish Creek]).

Pink Salmon counts were sufficient to generate escapement estimates to all rivers surveyed for Chum Salmon (Table C-2). Peak count estimates were generated for all streams and AUC estimates were produced for Ksi Xts'at'kw (Stagoo Creek) and Illiance River. Overall, Pink

Salmon escapement estimates to the Nass Area in 2023 were well above average to most systems.

Otolith Collection

Over two trips (10 and 19 September), 263 otolith samples were collected from Chum Salmon carcasses in Ksi Kswan (Kshwan River). Otoliths were sent to Alaska for analysis and none of the fish sampled were strays from nearby Alaskan hatcheries.

Water Quality

No unusual temperatures were measured, with water temperature ranging from 7.5°C in Ksi Xts'at'kw (Stagoo Creek) in mid-July to 16.0°C in Ksi Xmaat'in (Dogfish Creek) in mid-August (Table 4).

RECOMMENDATIONS

1. Continue to conduct rigorous and repeatable ground surveys on at least five Nass Area Chum Salmon indicator systems (Ksi Kswan [Kshwan River], Ksi Xts'at'kw [Stagoo Creek], Dak River [Kitsault tributary], Illiance River, Wilauks Creek);
2. Conduct a minimum of three surveys per system to count Chum Salmon and other salmon present, with surveys spanning the peak spawning period;
3. Evaluate survey life combined with observer efficiency for variation within and among streams surveyed;
4. Continue to opportunistically collect biological samples (e.g., otoliths to assess potential straying from Alaskan hatcheries) from Chum Salmon sampled during escapement surveys for evaluating stock return status; and
5. Explore the potential of predicting in-season aggregate escapement estimates from historical regressions of indicator stream escapement to aggregate escapement estimates to guide management of commercial fisheries in Area 3 to meet or exceed the annual aggregate escapement goal (45,000).

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TABLES

Table 1. Nass Area indicator stream Chum Salmon escapement, 1980−2023 (NJTC 2024).

	Escapement to Nass Area indicator streams[a]								Nass Area escapement			
Year	Illiance River	Kitsault River	Ksemamaith Creek	Ksi Kswan (Kshwan River)	Ksi Gingolx (Kincolith River)	Ksi X'anmas (Kwinamass River)	Ksi Xts'at'kw (Stagoo Creek)	Wilauks Creek	Obs.[b]		EF[c]	Est.[d]
1980	3,000	8,600		20,000	100	800	1,500	1,000	35,000		1.6	55,070
1981	500	3,700	10	4,000	200	500	1,500	100	10,510		1.6	16,514
1982	400	800	25	10,000		100	500	100	11,925		1.6	18,808
1983	2,500	5,300	20	10,000	25	100	12,000	550	30,495		1.6	47,916
1984	5,000	6,500		8,000	200	500	15,000	1,000	36,200		1.6	56,958
1985	1,500	1,000		20,000	1	500	2,000	250	25,251		1.6	39,731
1986	1,200	3,000		20,000		150	2,500	75	26,925		1.6	42,524
1987	1,300	2,250	25	15,000		50	3,600		22,225		1.6	35,664
1988	350	1,500	100	15,000		100	1,000	250	18,300		1.6	28,862
1989	2,000	3,000	20	10,000	20		10,000		25,040		1.6	40,555
1990	10,000	1,000	20	6,500			8,000	500	26,020		1.6	41,108
1991	1,000	1,000	20	10,000		100			12,120		2.2	26,934
1992	1,506	3,000				100	3,500	700	8,806		3.2	28,325
1993	2,000	5,000		50,000		100	5,000	300	62,400		1.6	98,438
1994	4,000	8,500				10	10,000	400	22,910		3.2	73,692
1995	4,000	6,000		10,000	200	50	10,000	1,000	31,250		1.6	49,129
1996	400	1,320		10,000	50	100	4,000	450	16,320		1.6	25,657
1997	350			10,000		100	2,000	150	12,600		1.8	22,627
1998	3,000	12,530		50,000		50	30,000	2,000	97,580		1.6	153,936
1999	1,500	1,500		2,000		50	17,000	300	22,350		1.6	35,258
2000	1,200	1,696		2,000			6,500	300	11,696		1.6	18,561
2001	1,000	870		2,000	104	50	15,000	250	19,274		1.6	30,383
2002				3,000			5,000		8,000		1.8	14,753
2003				5,000			30,000		35,000		1.8	64,545
2004	1,500			15,000			12,000	400	28,900		1.7	49,276
2005	300		70	2,000	126		15,000	260	17,756		1.7	30,041
2006	1,800			15,000	20		13,000		29,820		1.7	51,382
2007				1,000	95		4,900		5,995		1.8	11,005
2008				1,000	24		640		1,664		1.8	3,055
2009	475		51	1,500			9,800	60	11,886		1.7	20,195
2010	170		68	500			4,200		4,938		1.7	8,515
2011			80	1,170			2,200		3,450		1.8	6,338
2012	113		32	1,100			7,925	56	9,226		1.7	15,676
2013	500	100	20	1,100			7,100	300	9,120		1.6	14,426
2014	419	AP	25	NI			8,200	63	8,707		2.3	20,396
2015	1,820	445	91	20,505			6,932	449	30,242		1.6	47,835
2016	902	351	51	3,265			8,139	418	13,126		1.6	20,762
2017	220	74		7,066			6,767	62	14,189		1.6	22,517
2018	1,828	457		17,125			9,164		28,574		1.6	45,975
2019	892	586		7,209			6,367		15,054		1.6	24,222
2020	82			55,461			3,489		59,032		1.7	102,159
2021	625	AP		58,369			10,602	84	69,680		1.7	118,809
2022	2,565	500		28,057		AP	30,466	169	61,757		1.6	98,003
2023	641	AP	47	23,624	NI	AP	7,088	AP	31,400		1.7	54,147
Averages:												
1980−1989	1,775	3,565	33	13,200	91	311	4,960	416	24,187		1.6	38,260
1990−1999	2,776	4,428	20	18,563	125	73	9,944	644	31,236		2.0	55,511
2000−2009	1,046	1,283	61	4,750	74	50	11,184	254	16,999		1.7	29,320
2010−2019	763	336	52	6,560			6,699	225	#	13,663	1.7	22,666
2020−2022	978	500	47	41,378			12,911	127	#	55,467	1.7	93,279

[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. 2019).

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

Table 2. Nass Area Chum Salmon harvest and exploitation rates, 1980−2023 (NJTC 2024).

	Canadian harvests						Exploitation rates (%)			
Year	Nisga'a[a]	Other[b]	Total	Total return to Canada	US harvest[c]	Total run	Nisga'a	Other Can.	US	Total
1980		55,777	55,777	110,847	141,011	251,858		22.1	56.0	78.1
1981		7,891	7,891	24,406	23,891	48,297		16.3	49.5	65.8
1982		10,581	10,581	29,389	6,082	35,470		29.8	17.1	47.0
1983		40,513	40,513	88,429	33,071	121,500		33.3	27.2	60.6
1984		62,955	62,955	119,914	42,679	162,593		38.7	26.2	65.0
1985		18,274	18,274	58,005	15,971	73,976		24.7	21.6	46.3
1986		24,323	24,323	66,847	49,602	116,448		20.9	42.6	63.5
1987		23,470	23,470	59,134	21,543	80,677		29.1	26.7	55.8
1988		8,755	8,755	37,618	20,601	58,218		15.0	35.4	50.4
1989		22,764	22,764	63,320	39,051	102,371		22.2	38.1	60.4
1990		19,398	19,398	60,506	36,677	97,183		20.0	37.7	57.7
1991		19,563	19,563	46,498	14,869	61,367		31.9	24.2	56.1
1992	200	25,291	25,491	53,817	13,223	67,040	0.3	37.7	19.7	57.7
1993	416	139,756	140,172	238,610	84,873	323,483	0.1	43.2	26.2	69.6
1994	579	31,181	31,760	105,452	43,990	149,443	0.4	20.9	29.4	50.7
1995	402	33,470	33,872	83,001	30,366	113,367	0.4	29.5	26.8	56.7
1996	269	14,483	14,752	40,410	20,848	61,258	0.4	23.6	34.0	58.1
1997	227	7,933	8,160	30,787	22,408	53,195	0.4	14.9	42.1	57.5
1998	983	27,088	28,071	182,007	107,688	289,695	0.3	9.4	37.2	46.9
1999	846	31,938	32,784	68,042	20,560	88,602	1.0	36.0	23.2	60.2
2000	1,067	6,525	7,592	26,153	4,022	30,175	3.5	21.6	13.3	38.5
2001	1,617	3,897	5,514	35,897	18,255	54,152	3.0	7.2	33.7	43.9
2002	132	2,859	2,991	17,744	1,727	19,472	0.7	14.7	8.9	24.2
2003	318	11,097	11,415	75,960	11,054	87,014	0.4	12.8	12.7	25.8
2004	1,115	7,338	8,453	57,729	23,878	81,608	1.4	9.0	29.3	39.6
2005	728	2,429	3,157	33,198	8,678	41,876	1.7	5.8	20.7	28.3
2006	1,214	7,882	9,095	60,478	12,353	72,830	1.7	10.8	17.0	29.4
2007	932	975	1,907	12,911	8,397	21,308	4.4	4.6	39.4	48.4
2008	511	185	697	3,751	436	4,187	12.2	4.4	10.4	27.0
2009	447	1,139	1,586	21,781	7,405	29,186	1.5	3.9	25.4	30.8
2010	386	242	628	9,143	1,002	10,146	3.8	2.4	9.9	16.1
2011	245	446	691	7,030	1,387	8,416	2.9	5.3	16.5	24.7
2012	394	415	809	16,485	2,180	18,664	2.1	2.2	11.7	16.0
2013	243	604	847	15,272	2,262	17,534	1.4	3.4	12.9	17.7
2014	711	422	1,133	21,529	2,789	24,318	2.9	1.7	11.5	16.1
2015	1,382	4,537	5,919	53,754	7,798	61,552	2.2	7.4	12.7	22.3
2016	2,923	193	3,117	23,879	4,645	28,524	10.2	0.7	16.3	27.2
2017	744	51	795	23,312	1,881	25,193	3.0	0.2	7.5	10.6
2018	535	554	1,089	47,064	2,909	49,973	1.1	1.1	5.8	8.0
2019	206	85	292	24,513	3,619	28,132	0.7	0.3	12.9	13.9
2020	80	0	80	102,238	11,778	114,017	0.1	0.0	10.3	10.4
2021	19	950	968	119,777	40,342	160,119	0.0	0.6	25.2	25.8
2022	507	998	1,505	99,508	17,911	117,419	0.4	0.8	15.3	16.5
2023	72	758	830	54,977	9,920	64,897	0.1	1.2	15.3	16.6
Averages:										
1980−1989		27,530	27,530	65,791	39,350	105,141		25.2	34.0	59.3
1990−1999	490	35,010	35,402	90,913	39,550	130,463	0.4	26.7	30.1	57.1
2000−2009	808	4,433	5,241	34,560	9,621	44,181	3.0	9.5	21.1	33.6
2010−2019	777	755	1,532	24,198	3,047	27,245	3.0	2.5	11.8	17.3
2020−2023	169	677	846	94,125	19,988	114,113	0.2	0.7	16.5	17.3

[a] 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 (2023).

[b] Canadian marine commercial catch is estimated from methods developed by the Pacific Salmon Foundation (English et al. 2019) and include commercial harvests in net fisheries only. 1980 and 1981 are estimated using the average percent Nass in commercial catch.

[c] US commercial catch is estimated from methods developed by the Pacific Salmon Foundation (English et al. 2019). Values for 1980 and 1981 were estimated using a 25% US ER (1982−1986 average).

Table 3. Access methods and travel time to Nass Area Chum Salmon streams surveyed in 2023.

Area	Stream	Access method	Travel	
			Time (hours)	From
Observatory Inlet	Ksi Xts'at'kw (Stagoo Creek)	Helicopter	0.5	Nass Camp
	Ksi Kswan (Kshwan River)	Helicopter	0.7	Nass Camp
	Illiance River	Helicopter	0.5	Nass Camp
	Wilauks Creek	Helicopter	0.5	Nass Camp
	Dak River	Helicopter	0.5	Nass Camp
Portland Canal	Ksi Xmaat'in (Dogfish Creek)	Boat	1.0	Gingolx
Lower Nass	Ksemamaith Creek	Truck	0.5	Gitlaxt'aamiks
	Gitzyon Creek	Truck	0.1	Gitlaxt'aamiks

Table 4. Survey dates, water temperature, and Chum Salmon counts for Nass Area streams surveyed in 2023.

Survey						Raw counts				Comments
Area	Stream name	Date	Length (m)	Method	Water temp.[a]	Live	Carcass	Weighted OE[b] (%)	OE expanded live	
Observatory Inlet	Ksi Xts'at'kw	21-Jul-2023	4,800	Walk	7.5	152	0	90	169	
	(Stagoo Creek)	07-Aug-2023	4,800	Walk	8.0	4,055	169	92	4,403	
		17-Aug-2023	4,800	Heli	9.0	1,235	44	80	1,544	
	Illiance River	07-Aug-2023	2,050	Walk	14.5	317	3	95	334	
		17-Aug-2023	2,050	Walk	11.0	154	2	95	162	
		26-Aug-2023	2,050	Walk	11.0	163	31	94	174	
	Wilauks Creek	17-Aug-2023	1,000	Heli	11.0	2	0	80	2	
		26-Aug-2023	1,000	Heli	na	8	0	90	9	
	Dak River	17-Aug-2023	0	Heli	na	na		0	na	Glacial flow; could not be counted.
		26-Aug-2023	700	Walk	11.0	11	3	75	15	Flow braided through forest after 700m
	Ksi Kswan	27-Aug-2023	1,800	Walk	NR	156	14	89	175	
	(Kshwan River)	08-Sep-2023	1,800	Walk	NR	7,980	692	92	8,697	
		19-Sep-2023	1,800	Walk	8.5	7,650	1,836	89	8,640	
Portland Canal	Ksi Xmaat'in	10-Aug-2023	1,500	Walk	16.0	7	0	100	7	
	(Dogfish Creek)	23-Aug-2023	3,000	Walk	13.0	41	89	100	41	Over 250,000 pinks estimated
Lower Nass	Ksemamaith Creek	12-Aug-2023	700	Walk	11.5	21	3	95	22	
	Gityzon Creek	12-Aug-2023	1,000	Walk	12.0	0	0	NA	0	Only Pink and Sockeye observed

[a] NR = not recorded.

[b] This is the calculated from reach-specific estimates of observer efficiency (OE) for all reaches successfully surveyed and is weighted by the estimated number of fish in each reach.

Table 5. Summary of Ksi Xts'at'kw (Stagoo Creek) Chum Salmon escapement estimates, 1994−2023.

		Survey dates		Method		Peak[a]					AUC				Escapement[b]	
Year	No. surveys	First	Last	Survey	Escapement estimate[a]	Date	Count	EF	Cumulative carcass	Estimate	OE (%)	RT (days)	No. surveys	Estimate	NuSEDS	Quality
1994	8	30-Jun	08-Sep	Walk; Plane	Not specified	03-Aug	3,500	2.9		10,000					10,000	4
1995	8	06-Aug	07-Oct	Walk; Plane	Not specified	06-Aug	6,500	1.5		10,000					10,000	3
1996	9	24-Jul	29-Aug	Walk; Plane	Not specified	18-Aug	1,275	3.1		4,000					4,000	5
1997	5	06-Aug	04-Sep	Walk; Plane	Not specified	09-Aug	500	4.0		2,000					2,000	5
1998	13	16-Jul	22-Oct	Walk; Plane; Heli	Not specified	01-Aug	20,000	1.5		30,000					30,000	3
1999	7	01-Aug	15-Sep	Walk, Plane; Heli	Not specified	07-Aug	8,706	2.0		17,000					17,000	3
2000	7	02-Aug	13-Sep	Walk; Plane; Heli	Not specified	14-Aug	4,140	1.6		6,500					6,500	3
2001	6	29-Jul	10-Sep	Walk; Plane; Heli	Not specified	11-Aug	9,511	1.6		15,000					15,000	4
2002	3	11-Aug	10-Sep	Walk; Heli	Not specified	21-Aug	3,100	1.6		5,000					5,000	4
2003	6	25-Jul	25-Aug	Walk; Heli	Not specified	11-Aug	18,050	1.7		30,000					30,000	4
2004	6	02-Jul	31-Aug	Walk; Heli	Expert opinion	13-Aug	8,520	1.4		12,000					12,000	3
2005	6	13-Jul	03-Sep	Walk (5); Heli (1)	Expert opinion	08-Aug	7,500	2.0		15,000	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					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	3,379	2.0	174	6,932					6,932	4
2016	5	15-Jul	06-Sep	Walk	AUC	06-Aug	2,756	2.0		5,512	62	10	4	8,139	8,139	3
2017[d]	2	16-Jul	06-Sep	Walk	Peak count x 2	06-Aug	3,365	2.0	37	6,767					6,767	4
2018	4	15-Jul	20-Aug	Walk	AUC	08-Aug	7,810	2.0		15,620	75	10	4	9,164	9,164	3
2019	4	22-Jul	16-Aug	Walk	AUC	08-Aug	4,676	2.0		9,352	71	10	4	6,367	6,367	3
2020	2	25-Jul	13-Aug	Walk; Heli	Peak count x 2	13-Aug	1,711	2.0	67	3,489					3,489	4
2021	3	21-Jul	21-Aug	Walk; Heli	Peak count x 2	21-Aug	5,219	2.0	165	10,602					10,602	4
2022	4	17-Jul	16-Aug	Walk; Heli	AUC	16-Aug	14,900	2.0	970	30,770	75	10	4	30,466	30,466	3
2023	3	21-Jul	17-Aug	Walk; Heli	AUC	07-Aug	4,403	2.0	169	8,975	87	10	4	7,088	7,088	3
Min	2	30-Jun	13-Aug			27-Jul	172	1.1	37	2,000	60	10	3	633	640	3
Max	13	11-Aug	22-Oct			22-Aug	20,000	4.0	970	30,770	100	15	5	30,466	30,466	5
Mean	5	23-Jul	05-Sep			09-Aug	5,875	2.0	264	11,797	84	11	4	9,727	10,220	4

[a] EF = Expansion factor

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

[c] From DFO BC16 records and Stream Estimate Narrative data.

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

Table 6. Summary of Ksi Kswan (Kshwan River) Chum Salmon escapement estimates, 1994−2023.

		Survey dates		Method		Peak[a]					AUC				Escapement[b]	
Year	No. surveys	First	Last	Survey	Escapement estimate[c]	Date	Count	EF	Cumulative carcass	Estimate	OE (%)	RT (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					10,000	4
1996	2	22-Aug	07-Sep	Walk	Not specified		6,575	1.5		10,000					10,000	5
1997	1	07-Sep		Walk	Not specified		4,849	2.1		10,000					10,000	5
1998	3	01-Aug	07-Oct	Walk	Not specified	09-Sep	36,090	1.4		50,000					50,000	4
1999	1	15-Sep		Walk	Expert opinion		147	13.6		2,000					2,000	5
2000	1	22-Sep		Walk	Expert opinion		211	9.5		2,000					2,000	5
2001	1	17-Sep	19-Oct	Walk	Expert opinion		724	2.8		2,000					2,000	5
2002	1	21-Sep		Walk	Expert opinion		1,261	2.4		3,000					3,000	5
2003	1	23-Sep	24-Sep	Walk	Expert opinion		1,988	2.5		5,000					5,000	5
2004	1	06-Sep		Walk	Expert opinion		7,772	1.9		15,000					15,000	5
2005	2	17-Aug	11-Sep	Walk	Expert opinion		1,043	1.9		2,000					2,000	5
2006	3	13-Aug	12-Sep	Walk	Expert opinion	12-Sep	9,920	1.5		15,000					15,000	5
2007	2	31-Aug	12-Sep	Walk	Expert opinion		519	1.9		1,000					1,000	5
2008	1	15-Sep		Walk	Expert opinion		977	1.0		1,000					1,000	6
2009	3	13-Sep	25-Sep	Walk	Expert opinion	14-Sep	769	2.0		1,500					1,500	4
2010	1	16-Sep		Walk	Expert opinion		381	1.3		500					500	5
2011	1	15-Sep		Walk	Expert opinion		1,162	1.0		1,170					1,170	5
2012	2	15-Sep	16-Sep	Walk	Expert opinion	16-Sep	873	1.3		1,100					1,100	4
2013				Unknown	Unknown										1,100	4
2014				Not surveyed											NI	6
2015	8	31-Aug	02-Oct	Walk	Peak count x 2	10-Sep	8,640	2.0	3,225	20,505					20,505	3
2016	5	19-Aug	21-Sep	Walk	AUC	27-Aug	1,381	2.0	174	2,936	70	10	3	3,265	3,265	3
2017	4	17-Aug	20-Sep	Walk	Peak count x 2	20-Sep	3,320	2.0	426	7,066					7,066	4
2018	5	18-Aug	11-Sep	Walk	Peak count x 2	11-Sep	7,754	2.0	1,617	17,125					17,125	4
2019	2	04-Sep	11-Sep	Walk	Peak count x 2	11-Sep	3,456	2.0	297	7,209					7,209	4
2020	2	08-Sep	22-Oct	Walk	Peak count x 2	08-Sep	27,287	2.0	887	55,461					55,461	4
2021	1	08-Sep		Walk	Peak count x 2	08-Sep	22,218	2.0	2,096	46,532					58,369	4
2022	3	08-Sep	01-Oct	Walk	AUC	08-Sep	14,633	2.0	1,025	30,292	91	10	3	28,057	28,057	3
2023	3	27-Aug	19-Sep	Walk	AUC	08-Sep	8,697	2.0	706	18,100	90	10	3	23,624	23,624	3
Min	1	23-Jul	07-Sep			27-Aug	147	1.0	174	500	70	10	3	3,265	500	3
Max	8	23-Sep	22-Oct			20-Sep	36,090	13.6	3,225	55,461	91	10	3	28,057	58,369	6
Mean	2	02-Sep	22-Sep			10-Sep	6,589	2.6	1,161	12,284	81	10	3	15,661	12,238	5

[a] EF = Expansion factor

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

[c] For 1994 to 2011, from DFO BC16 records and Stream Estimate Narrative data.

[d] NI = Not inspected.

Table 7. Summary of Wilauks Creek Chum Salmon escapement estimates, 1994−2023.

		Survey dates		Method		Peak[a]					AUC				Escapement[b]	
Year	No. surveys	First	Last	Survey	Escapement estimate[c]	Date	Count	EF	Cumulative carcass	Estimate	OE (%)	RT (days)	No. surveys	Estimate	NuSEDS[d]	Quality
1994	3	20-Jul	12-Sep	Walk	Not specified	20-Aug	236	1.7		400					400	5
1995	9	20-Jul	09-Oct	Walk	Not specified	01-Aug	532	1.9		1,000					1,000	5
1996	10	20-Jul	05-Oct	Walk	Not specified	13-Aug	115	3.9		450					450	4
1997	5	09-Aug	07-Sep	Walk	Not specified	07-Sep	85	1.8		150					150	4
1998	13	16-Jul	23-Oct	Plane; Walk	Not specified	11-Aug	413	4.8		2,000					2,000	3
1999	9	05-Aug	05-Oct	Walk	Not specified	20-Aug	132	2.3		300					300	4
2000	10	03-Aug	31-Oct	Walk	Not specified	17-Aug	95	3.2		300					300	4
2001	12	31-Jul	29-Oct	Walk	Not specified	30-Aug	139	1.8		250					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					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					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	2.0		430	80	10	4	449	449	3
2016	5	27-Jul	07-Sep	Walk	AUC	17-Aug	217	2.0		434	67	10	4	418	418	3
2017	2	30-Jul	07-Sep	Walk	Maximum count x 2		31	2.0	0	62					62	5
2018	3	30-Jul	17-Aug	Walk	No estimate			2.0		0					NO	6
2019	2	31-Jul	08-Aug	Walk; Heli	No estimate			2.0		0					NO	6
2020	2	25-Jul	13-Aug	Walk	No estimate		6	2.0	0	12					AP	6
2021	2	29-Jul	01-Sep	Walk; Heli	Maximum count x 2		42	2.0	0	84					84	5
2022	3	28-Jul	01-Sep	Heli	AUC	16-Aug	55	2.0	2	112	75	10	3	169	169	3
2023	2	17-Aug	26-Aug	Heli	No estimate		9	2.0	0	18					AP	6
Min	1	16-Jul	08-Aug			01-Aug	2	1.7	0	0	67	10	3	63	56	3
Max	13	20-Aug	31-Oct			07-Sep	532	4.8	2	2,000	80	10	5	449	2,000	6
Mean	6	31-Jul	13-Sep			17-Aug	128	2.3	1	358	73	10	4	272	382	5

[a] EF = Expansion factor.

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

[c] From DFO BC16 records and Stream Estimate Narrative data for 1994 to 2014.

[d] AP = Adults present; NI = Not inspected; NO = None observed.

Table 8. Summary of Illiance River Chum Salmon escapement estimates, 1994−2023.

		Survey dates		Method		Peak[a]				AUC				Escapement[b]	
Year	No. surveys	First	Last	Survey	Escapement estimate[c]	Date	Count	EF	Cumulative carcass	Estimate	OE (%)	RT (days)	No. surveys	Estimate	NuSEDS[d]	Quality
1994	4	20-Jul	12-Sep	Walk	Not specified	27-Aug	1,650	2.4		4,000					4,000	3
1995	10	20-Jul	09-Oct	Walk	Not specified	01-Aug	2,377	1.7		4,000					4,000	3
1996	10	20-Jul	05-Oct	Walk	Not specified	13-Aug	184	2.2		400					400	3
1997	9	09-Aug	10-Oct	Walk; Heli	Not specified	07-Sep	227	1.5		350					350	3
1998	13	16-Jul	11-Oct	Walk; Heli	Not specified	11-Aug	1,044	2.9		3,000					3,000	3
1999	10	26-Jul	05-Oct	Walk	Not specified	20-Aug	401	3.7		1,500					1,500	4
2000	10	03-Aug	12-Oct	Walk	Not specified	09-Sep	678	1.8		1,200					1,200	3
2001	12	31-Jul	12-Oct	Walk	Not specified	30-Aug	290	3.4		1,000					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					1,500	5
2005	9	08-Jul	19-Sep	Walk	Expert opinion	17-Aug	178	1.7		300					300	4
2006[d]	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					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	2.0		1,346	61	10	5	1,836	1,836	3
2016	5	26-Jul	07-Sep	Walk	AUC	26-Jul	268	2.0		536	69	10	4	902	902	3
2017	2	30-Jul	07-Sep	Walk	Maximum count x 2		110	2.0	0	220					220	5
2018	5	30-Jul	12-Sep	Walk	AUC	17-Aug	572	2.0		1,144	80	10	4	1,828	1,828	3
2019	3	31-Jul	16-Aug	Walk	Peak count x 2	16-Aug	425	2.0	42	892					892	4
2020	2	25-Jul	13-Aug	Walk	Peak count x 2	13-Aug	41	2.0	0	82					82	4
2021	3	29-Jul	01-Sep	Walk	AUC	21-Aug	325	2.0	10	659	67	10	3	625	625	3
2022[e]	3	28-Jul	01-Sep	Walk	AUC	16-Aug	1,141	2.0	57	2,339	81	10	3	2,565	2,565	3
2023	3	07-Aug	26-Aug	Walk	AUC	07-Aug	334	2.0	3	671	95	10	3	641	641	3
Min	1	08-Jul	13-Aug			26-Jul	8	1.5	0	82	61	10	3	419	82	3
Max	13	28-Aug	12-Oct			09-Sep	2,377	3.7	57	4,000	100	10	5	2,565	4,000	6
Mean	6	30-Jul	14-Sep			17-Aug	500	2.2	19	1,297	80	10	3	1,233	1,269	4

[a] EF = Expansion factor.

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

[c] For 1994 to 2011, from DFO BC16 records and Stream Estimate Narrative data.

[d] AP = Adults present.

[e] A planned fourth survey was cancelled to low clouds/fog in the mountain pass approaching Illiance via helicopter.

Table 9. Summary of Kitsault River Chum Salmon escapement estimates, 1994−2023.

		Survey dates				Method		Peak[c]					AUC				Escapement[d]	
Year	No. surveys[a]	First	Last	Tributaries surveyed[b]	Dak River surveyed	Survey	Escapement estimate	Date	Count	EF	Cumulative carcass	Estimate	OE (%)	RT (days)	No. surveys	Estimate	NuSEDS	Quality
1994	1–7	01-Jul	13-Sep	6	Y	Boat; Walk	Not specified	28-Aug	4,098	2.1		8,500					8,500	4
1995	2–9	14-Jul	18-Sep	7	Y	Walk	Not specified	02-Aug	4,278	1.4		6,000					6,000	4
1996	5–10	15-Jul	22-Sep	7	Y	Walk	Not specified	18-Aug	506	2.6		1,320					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	3,630	3.5		12,530					12,530	4
1999	1–5	25-Jul	05-Oct	7	Y	Walk	Not specified	17-Aug	503	3.0		1,500					1,500	4
2000	2–9	02-Aug	09-Oct	6	Y	Walk	Not specified	31-Aug	197	8.6		1,696					1,696	4
2001	3–13	21-Jul	21-Oct	7	Y	Walk	Not specified	21-Aug	609	1.4		870					870	4
2002						Not surveyed	No estimate										AP	6
2003	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											NI	6
2015	5	04-Aug	19-Sep	5	N	Walk	AUC	07-Sep	235	2.0		470	87	10	4	445	445	3
2016	6	26-Jul	07-Sep	2	N	Walk	AUC	07-Aug	132	2.0		264	71	10	4	351	351	3
2017	5	30-Jul	07-Sep	2	N	Walk	Maximum count x 2		37	2.0		74					74	5
2018	4	31-Jul	12-Sep	2	N	Walk	AUC	12-Sep	309	2.0		618	86	10	4	457	457	3
2019	3	31-Jul	16-Aug	2	Y	Walk	Peak count x 2	16-Aug	292	2.0	2	586					586	3
2020[e]					N	Not surveyed											NI	6
2021[e]	1	01-Sep		1	Y	Walk	Maximum count x 2		28	2.0	0	56					56	5
2022[e]	2	16-Aug	01-Sep	1	Y	Heli	Peak count x 2	16-Aug	250	2.0	0	500					500	5
2023[f]	1	26-Aug	26-Aug	1	Y	Heli; Walk	Peak count x 2	26-Aug	15	2.0	3	33					AP	6
Min	0	01-Jul	16-Aug	1				02-Aug	14	1.4	0	33	71	10	4	351	56	3
Max	13	01-Sep	31-Oct	7				16-Sep	4,278	8.6	3	12,530	87	10	4	457	12,530	6
Mean[j]	4	31-Jul	18-Sep	5				22-Aug	1,238	2.6	1	2,334	81	10	4	418	2,492	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, Layall Creek, and Stark Creek.

[c] EF = Expansion factor.

[d] 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; NI = Not inspected.

[e] 2020 and 2022: high flows prevented safe access to Dak River when visited; aerial count only in 2022. In 2021, high flows prevented a count at peak spawning.

[f] Dak River was visited on 17 August but could not be counted due to glacial flow.

Table 10. Summary of Ksemamaith Creek Chum Salmon escapement estimates, 1994−2023.

		Survey dates		Method		Peak[a]					AUC				Escapement[b]	
Year	No. surveys	First	Last	Survey	Escapement estimate	Date	Count	EF	Cumulative carcass	Estimate	O.E. (%)	R.T. (days)	No. surveys	Estimate	NuSEDS[c]	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	36	2.0	12	84	92	7	5	82	68	4
2011	4	31-Jul	22-Sep	Walk	AUC	28-Aug	18	2.0	1	37	78	7	4	80	80	3
2012	8	06-Aug	21-Sep	Walk	AUC	13-Aug	12	2.0	0	24	88	7	4	32	32	3
2013	6	01-Aug	12-Sep	Walk	AUC	27-Aug	8	2.0	0	16	92	7	5	20	20	3
2014	6	07-Aug	13-Sep	Walk	AUC	14-Aug	11	2.0	0	22	87	7	6	25	25	3
2015	5	06-Aug	14-Sep	Walk	AUC	24-Aug	37	2.0	5	79	85	7	4	91	91	3
2016	5	27-Jul	15-Sep	Walk	AUC	05-Sep	13	2.0	2	28	90	7	4	51	51	3
2017	6	27-Jul	26-Sep	Walk	No estimate	31-Aug	2	2.0	0	4					AP	6
2018	4	04-Aug	07-Sep	Walk	No estimate	n/a	0	2.0	0	0					NO	6
2019	5	31-Jul	15-Sep	Walk	No estimate	24-Aug	6	2.0	0	12					AP	6
2020	0			Not Surveyed	No estimate										NI	6
2021	0			Not Surveyed	No estimate										NI	6
2022	0			Not Surveyed	No estimate										NI	6
2023	1	12-Aug	12-Aug	Walk	Peak x 2	12-Aug	22	2	3	47					47	5
Min	2	27-Jul	12-Aug			31-Dec	0	2.0	0	0	78	7	4	20	20	3
Max	8	31-Aug	26-Sep			05-Sep	37	2.2	12	84	98	7	6	91	91	6
Avg	5	06-Aug	12-Sep			07-Jul	16	2.0	2	32	89	7	5	58	54	5

[a] EF = Expansion factor.

[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; blank = no entry in NuSEDS.

Table 11. Comparison of AUC and peak x 2 Chum Salmon escapement estimates for coastal Nass Area indicator streams, 2023.

	Area-under-the-curve (AUC)			Peak x2
Stream	**Lower 90% CI**	**Upper 90% CI**	**Estimate**	**estimate**
Ksi Xts'at'kw (Stagoo Creek)	3,769	29,370	7,088	8,976
Ksi Kswan (Kshwan River)	12,556	97,781	23,624	18,086
Illiance River	344	2,646	641	671
Wilauks Creek			NA	AP
Dak River			NA	AP
Dogfish Creek			NA	171
Ksemamaith Creek			NA	47
Total	16,669	129,797	31,353	27,951

FIGURES

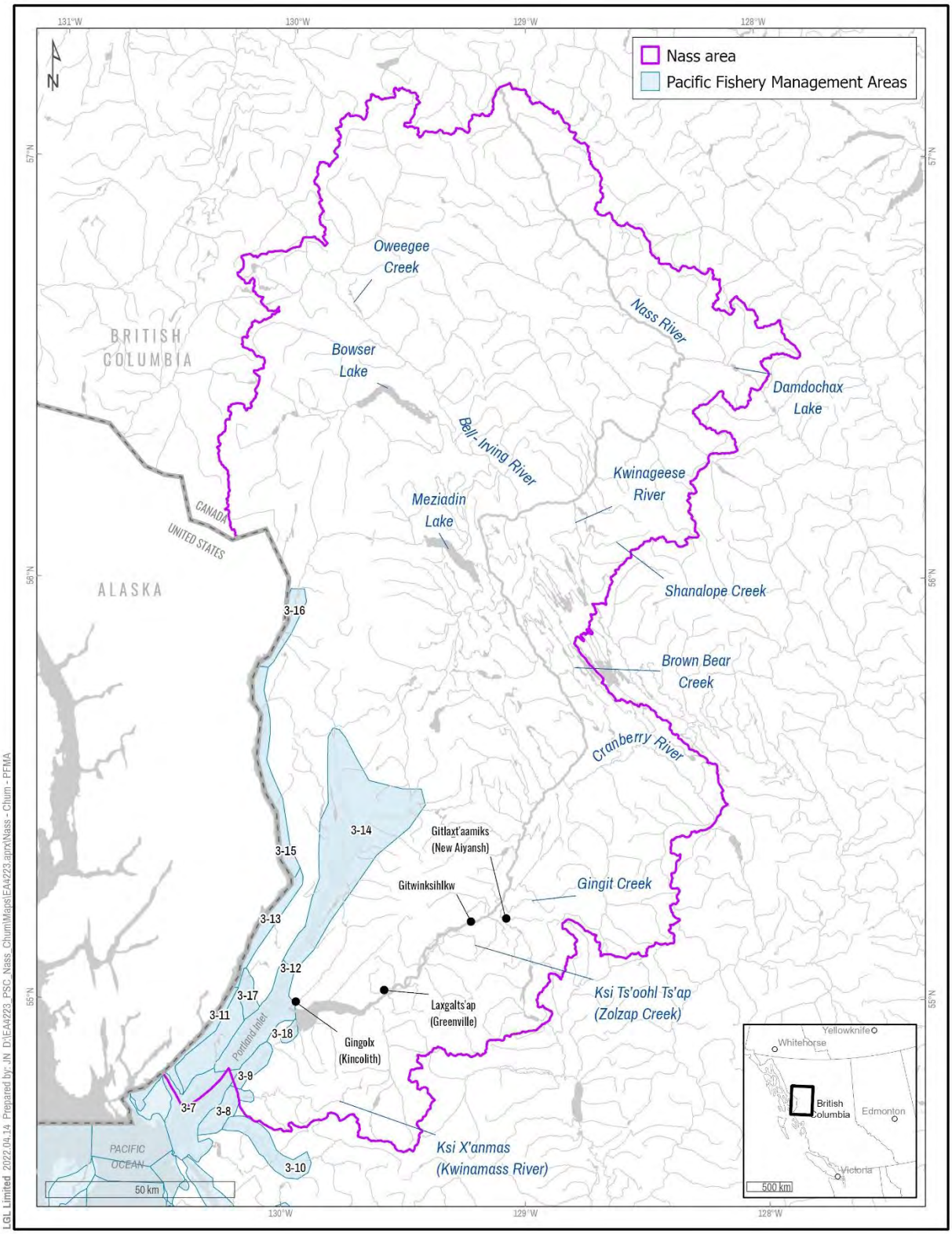


Figure 1. Pacific Fishery Management Area 3 and the Nass Area as defined by the Nisga'a Final Agreement.

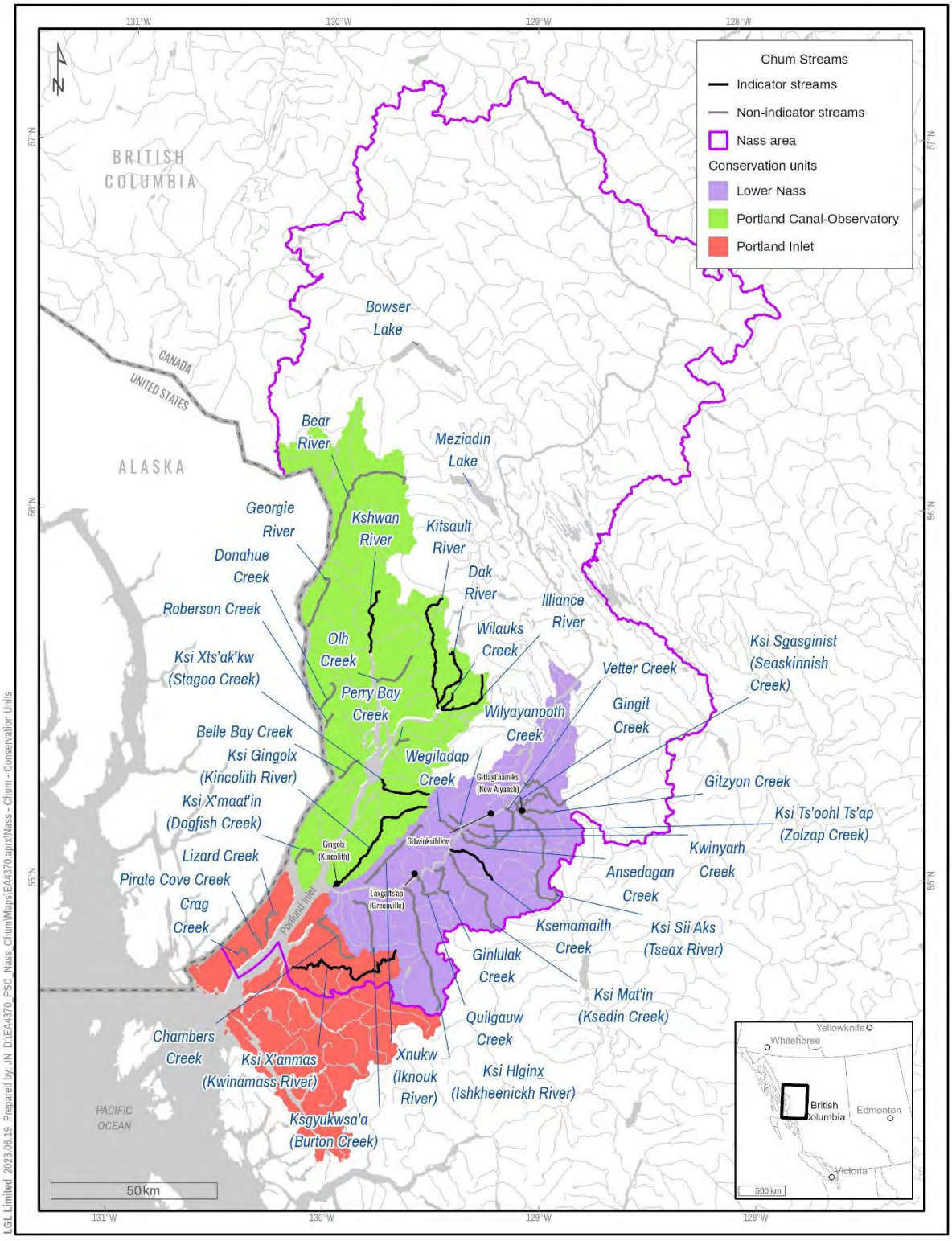


Figure 2. Nass Area Chum Salmon conservation units with indicator and non-indicator streams.

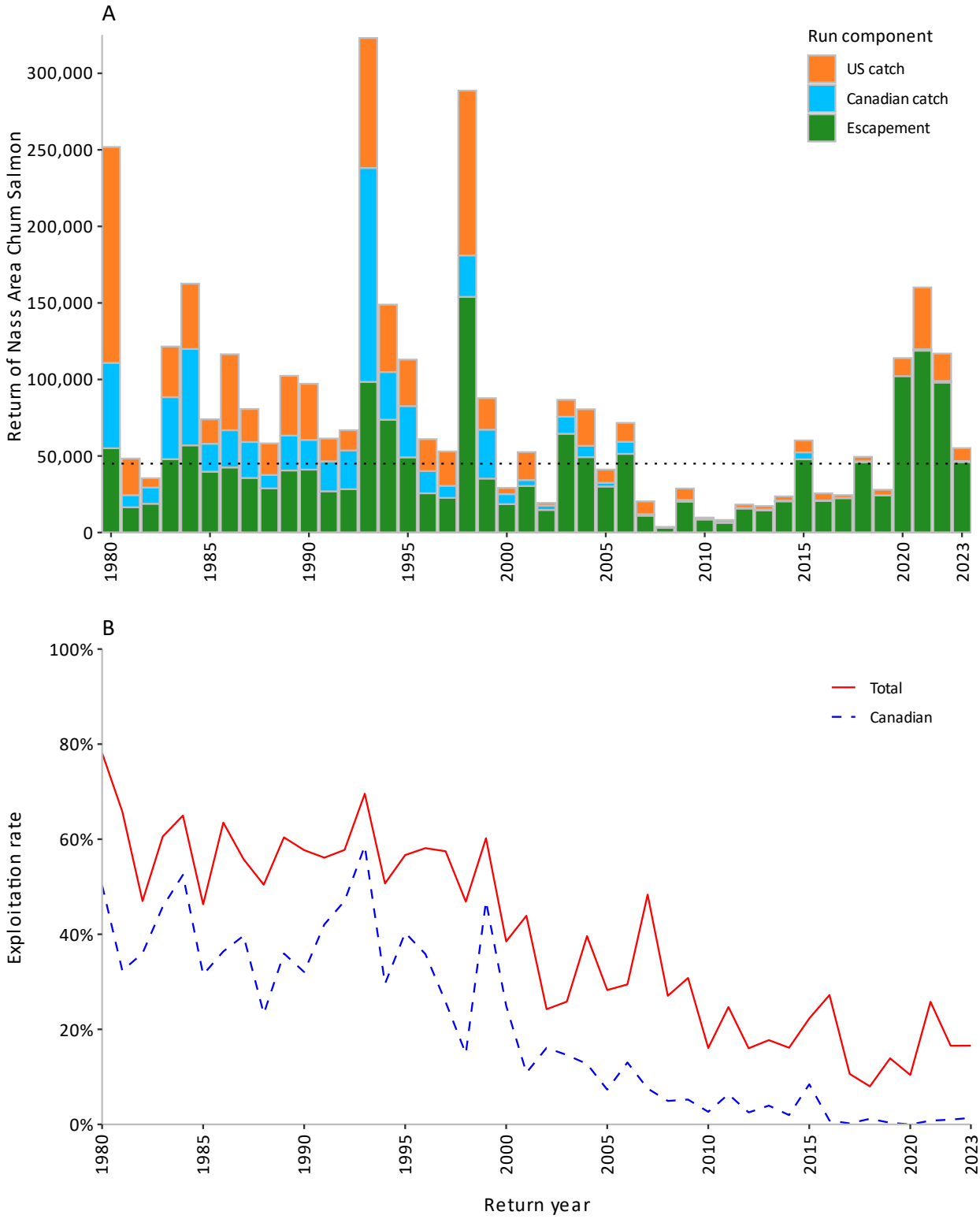


Figure 3. Nass Area Chum Salmon A) escapement and catch, and B) exploitation rates, 1980–2023. In panel A, the dotted line is the escapement goal (45,000).

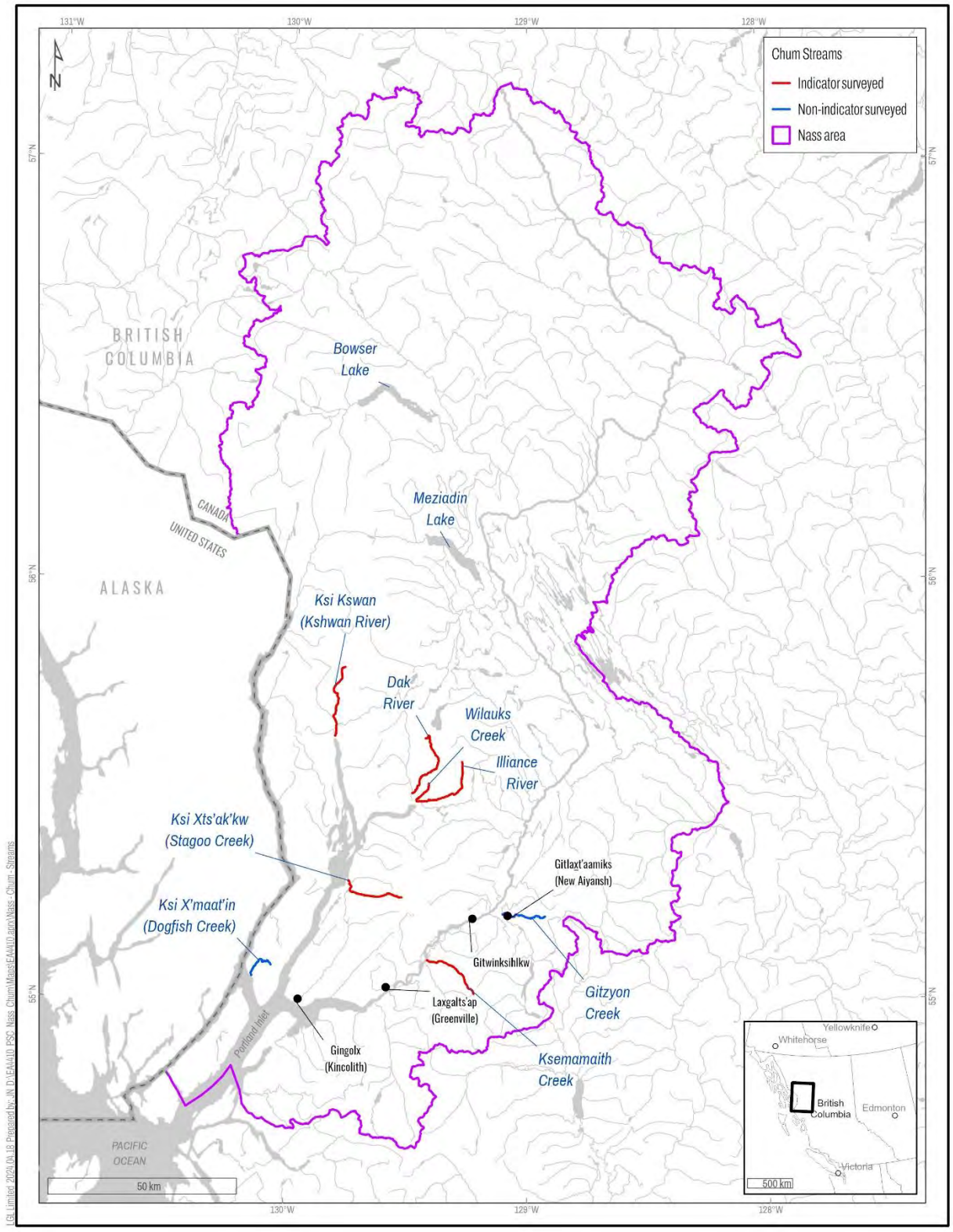


Figure 4. Nass Area Chum Salmon indicator and non-indicator streams surveyed in 2023.

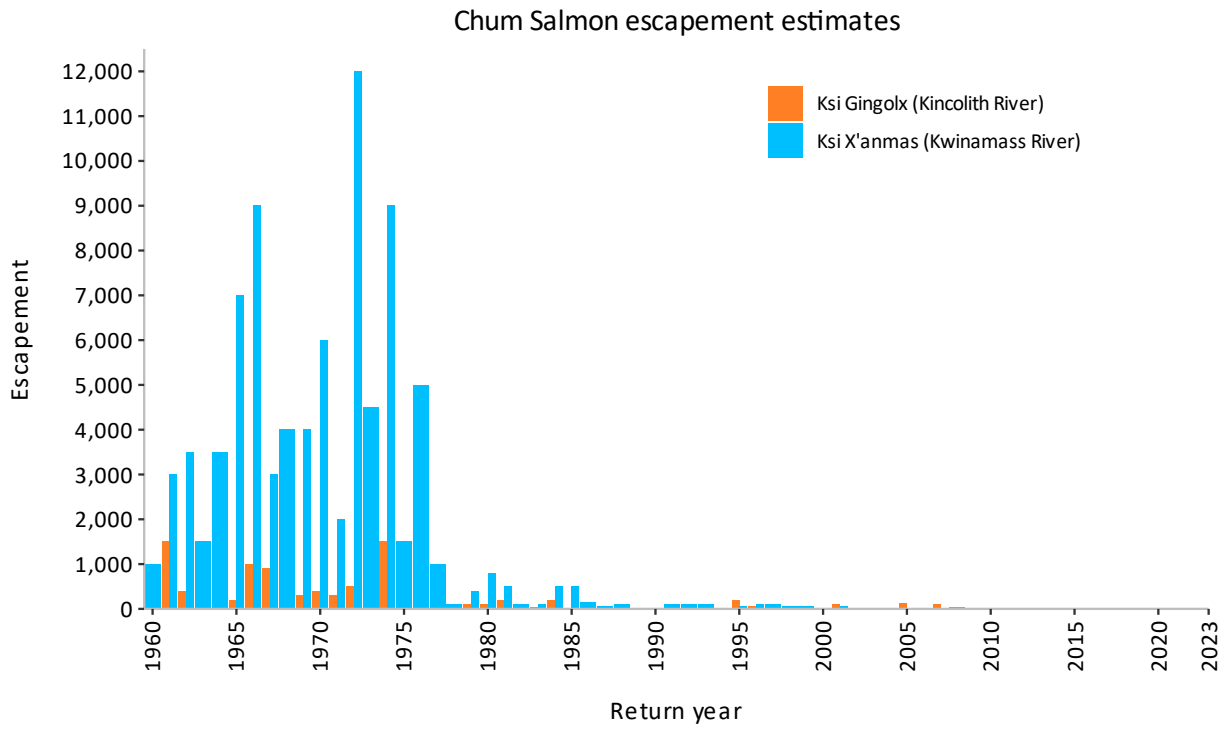


Figure 5. Annual Chum Salmon escapement estimates to Ksi Gingolx (Kincolith River) and Ksi X'anmas (Kwinamass River), 1960–2023. While both rivers are considered Chum Salmon indicator streams, returns to these relatively large systems have been very low since the late 1970s and they are not included in current escapement surveys.

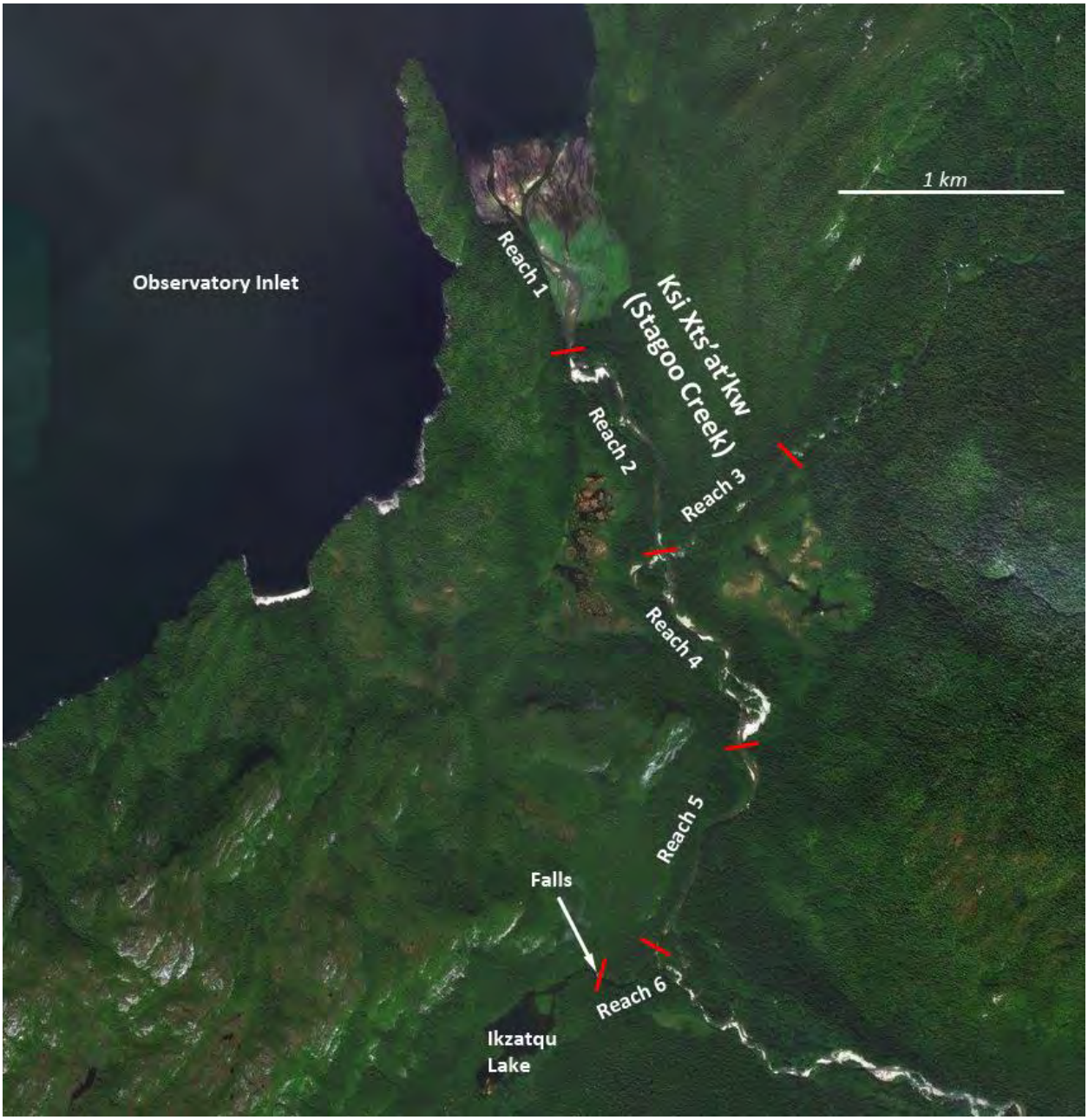


Figure 6. Ksi Xts'at'kw (Stagoo Creek) Chum Salmon survey reaches. Most spawning is observed in Reach 4.

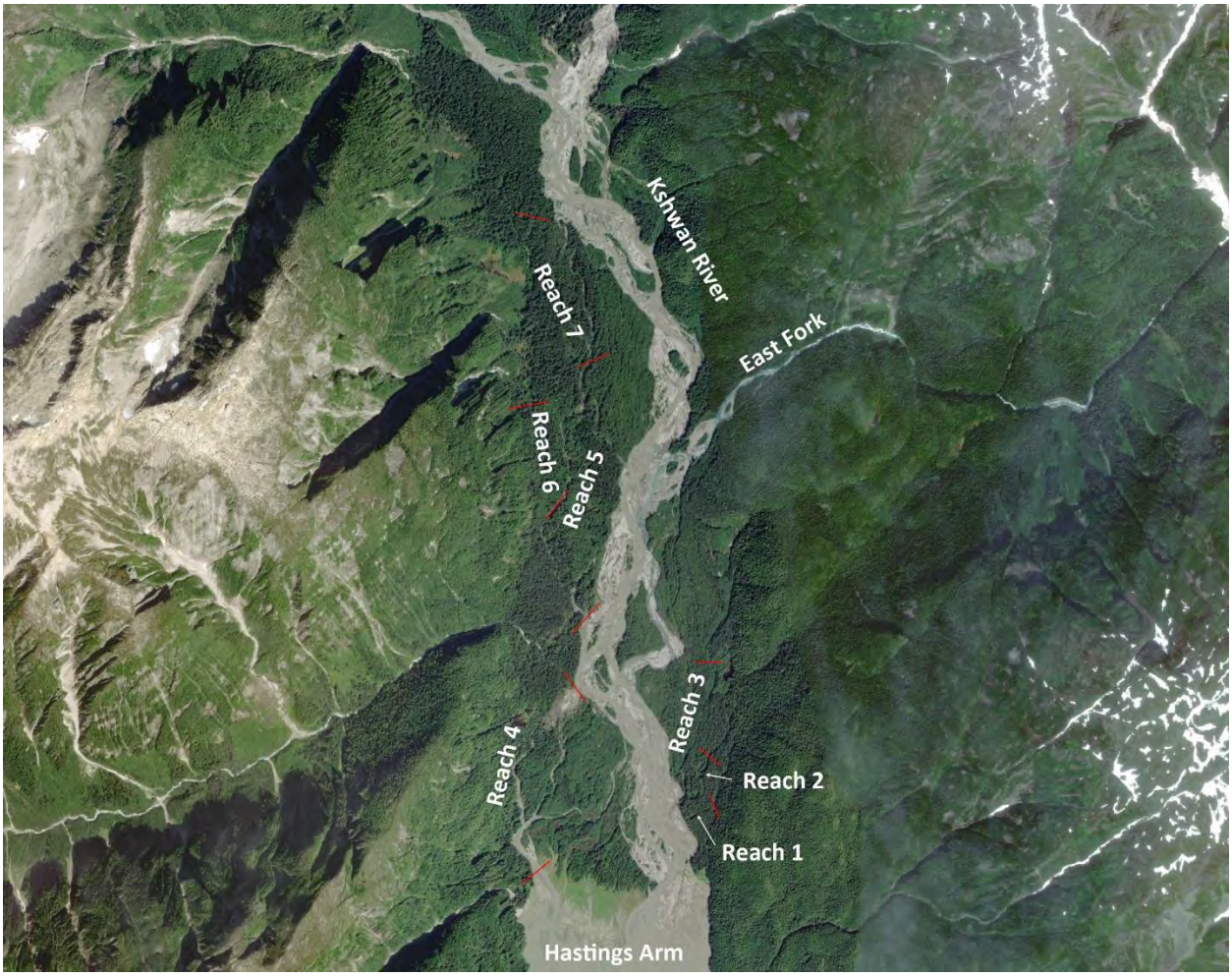


Figure 7. Ksi Kswan (Kshwan River) Chum Salmon side-channel and tributary survey reaches. Most spawning occurs on river-right in reaches 4 to 7.

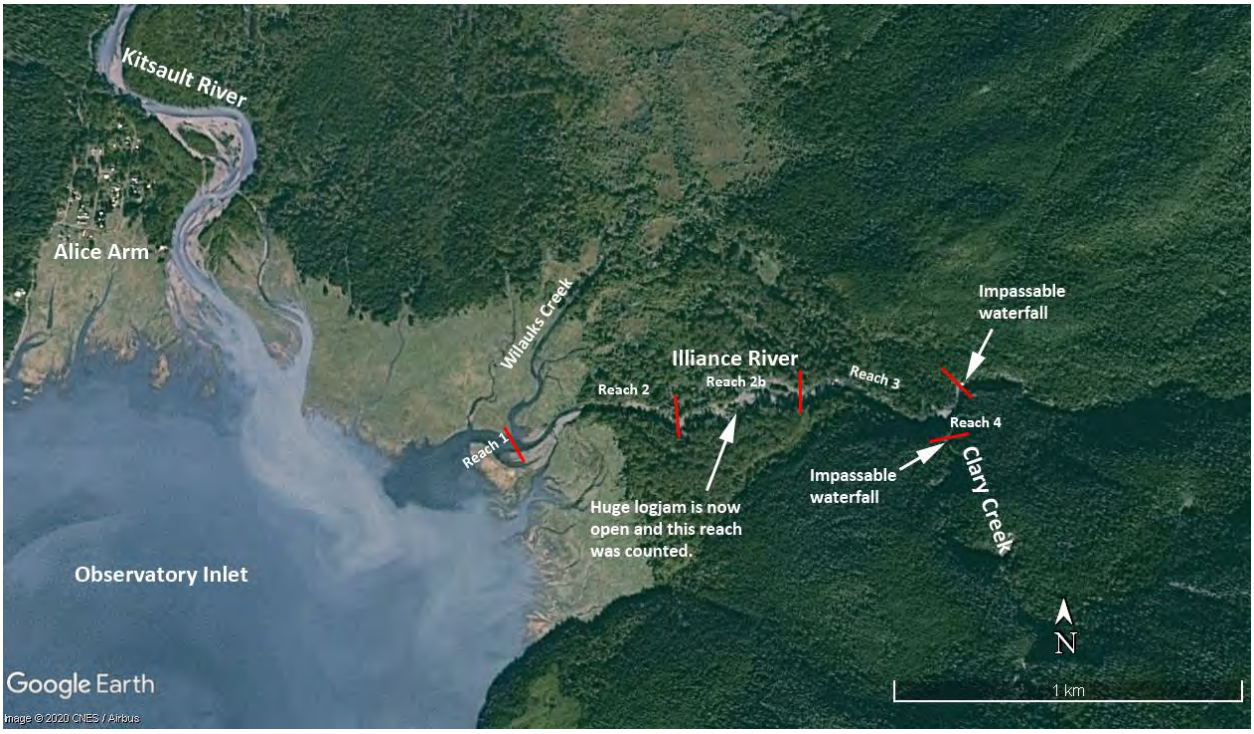


Figure 8. Illiance River Chum Salmon survey reaches. In previous years, Illiance River had a very large log jam and for safety reasons, that reach was not counted. The log jam was opened during the 2021 freshet and this reach is now included in survey counts. Reaches 3 and 4 both end at waterfalls.

Figure 9. Wilauks Creek Chum Salmon survey reaches.

Figure 10. Kitsault and Dak rivers Chum Salmon survey reaches. With a helicopter, we can access Dak River, an historically important Chum Salmon spawning stream. The Kitsault side-channel is typically only surveyed when we cannot access Dak River.

Figure 11. Ksi Xmaat'in (Dogfish Creek) Chum and Pink salmon survey reaches.

Figure 12. Ksemamaith Creek salmon survey reaches.

Figure 13. Gitzyon Creek salmon survey reaches. Only reach 1 was counted in 2023.

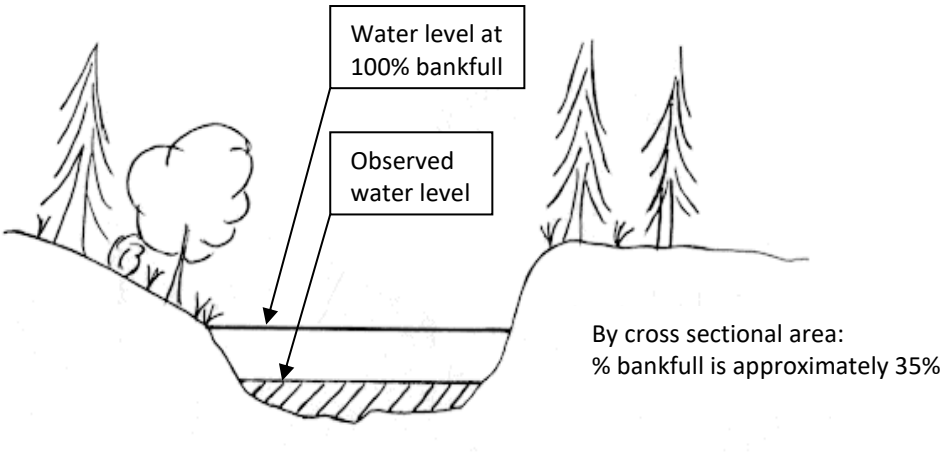


Figure 14. Estimating percent bankfull based on the portion of the channel that is wetted. Figure was copied from DFO Stream Inspection Log definitions.

PHOTOS

Photo 1. Representative images of Ksi Xts'at'kw (Stagoo Creek).

Counting conditions in reach 7, August 27.

Turbid side-channel due to flow from the mainstem of Ksi Kswan.

Counting conditions and Chum spawners, September 8.

Chum Salmon carcasses collected for otolith sampling, September 10.

Photo 2. Representative images of Ksi Kswan (Kshwan River) side-channel survey areas and carcasses, 2023.

Illiance River

Illiance River

Illiance River

Illiance River waterfall

Clary Creek

Clary Creek waterfall

Photo 3. Representative images of Illiance River and Clary Creek (Illiance tributary), 2023. Surveys in both streams end at waterfalls.

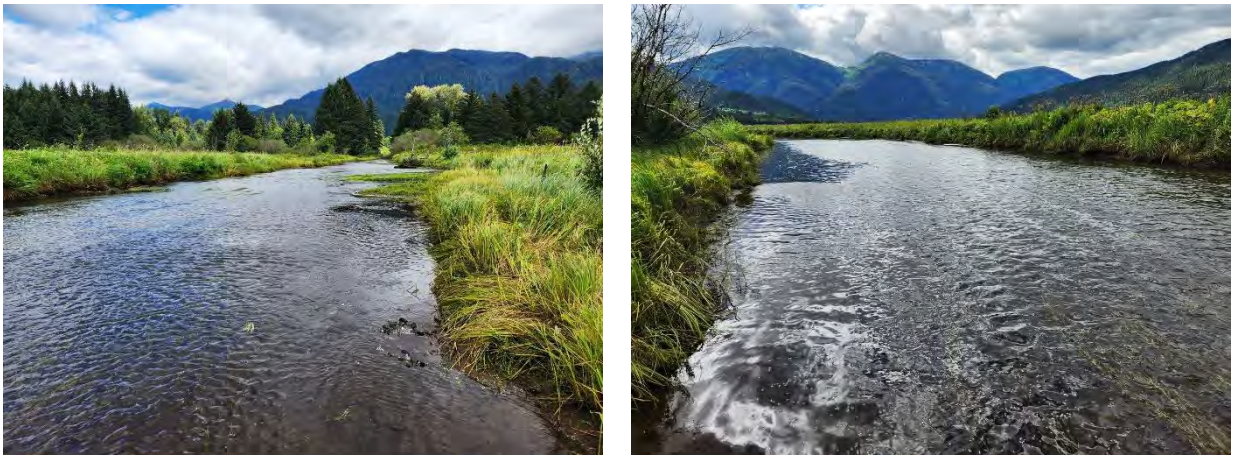
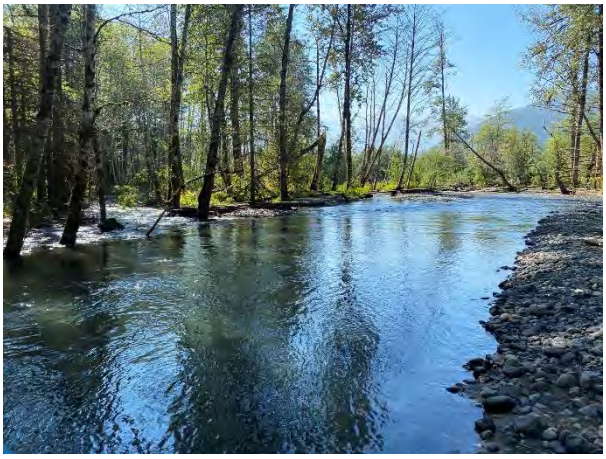


Photo 4. Representative images of Wilauks Creek, 2023.

Flow braided through the forest.

Excellent counting conditions.



Multiple channels into the forest.

Photo 5. Representative images of Dak River, 2023. Dak River is an historically important Chum Salmon spawning area for the Kitsault River.






Large school of Pink Salmon, 10 August 2023 Large school of Pink Salmon, 10 August 2023

Photo 6. Representative images of Ksi Xmaat'in (Dogfish Creek) and large schools of Pink Salmon.

Clear conditions and a Chum Salmon (blue arrow)

Clear conditions and Pink Salmon (below log)

Photo 7. Ksemamaith Creek counting conditions, 12 August 2023.

Photo 8. Gitzyon Creek counting conditions, 12 August 2023.

APPENDICES

Appendix A – Field forms.

Table A-1. Nisga'a Fisheries and Wildlife Department coastal stream escapement survey form.

NFWD Coastal Stream Escapement								Stream Name:					Crew:	
Date (YYYY/MM/DD):					Method (circle): Dead Pitch Streamwalk Snorkel Heli Other:								Water Temp (°C):	
Reach: Start time	**Live Count**				**Carcass Count**			**Wind**	**Bright-ness**	**Precip.**	**Water Colour**	**% Bankfull**	**Stream Visibility**	**Comments (wildlife; photos; other species; tags; etc)**
	Chum	**Pink**	**Coho**	**Obs. Eff. (%)**	**Chum**	**Pink**	**Coho**							
1:								None Light Moderate Strong	Full Bright Medium Dark	None Light Mod. Heavy Very Heavy	Clear Tea Slight Muddy Glacial	<25 25-50 50-75 75-100 >100	High Moderate Low	
2:								None Light Moderate Strong	Full Bright Medium Dark	None Light Mod. Heavy Very Heavy	Clear Tea Slight Muddy Glacial	<25 25-50 50-75 75-100 >100	High Moderate Low	
3:								None Light Moderate Strong	Full Bright Medium Dark	None Light Mod. Heavy Very Heavy	Clear Tea Slight Muddy Glacial	<25 25-50 50-75 75-100 >100	High Moderate Low	
4:								None Light Moderate Strong	Full Bright Medium Dark	None Light Mod. Heavy Very Heavy	Clear Tea Slight Muddy Glacial	<25 25-50 50-75 75-100 >100	High Moderate Low	
5:								None Light Moderate Strong	Full Bright Medium Dark	None Light Mod. Heavy Very Heavy	Clear Tea Slight Muddy Glacial	<25 25-50 50-75 75-100 >100	High Moderate Low	
6:								None Light Moderate Strong	Full Bright Medium Dark	None Light Mod. Heavy Very Heavy	Clear Tea Slight Muddy Glacial	<25 25-50 50-75 75-100 >100	High Moderate Low	
Totals														
Comments:														

Table A-2. Nisga'a Fisheries and Wildlife Department salmon bio-sample 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	M F		None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
			CM SK CH CO	M F		None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
			CM SK CH CO	M F		None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
			CM SK CH CO	M F		None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
			CM SK CH CO	M F		None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
			CM SK CH CO	M F		None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
			CM SK CH CO	M F		None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
			CM SK CH CO	M F		None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
			CM SK CH CO	M F		None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
			CM SK CH CO	M F		None Oper. Spag. Anch.		None Punch V-Clip				Live Fresh Old Rotten	
Comments:													

Appendix B – Fisheries and Oceans Canada escapement estimate classification.

Table B-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 C – Counts and escapement estimates for Pink Salmon.

Table C-1. Pink Salmon counts for each Nass Area stream surveyed in 2023.

Survey					Pink		
Area	Stream name	Date	Length (m)	Weighted observer efficiency (%)	Raw live	Expanded live	Carcass
Observatory Inlet	Ksi Xts'at'kw	21-Jul-2023	4,800	90	5,652	6,279	0
	(Stagoo Creek)	07-Aug-2023	4,800	92	11,735	12,646	0
		17-Aug-2023	4,800	80	11,950	14,938	0
	Illiance River	07-Aug-2023	2,050	95	3,850	4,053	0
		17-Aug-2023	2,050	95	2,698	3,880	19
		26-Aug-2023	2,050	94	3,256	3,394	298
	Wilauks Creek	17-Aug-2023	1,000	80	686	1,055	4
		26-Aug-2023	1,000	90	4,000	4,444	0
	Dak River	17-Aug-2023	0	0			
		26-Aug-2023	700	75	1,441	1,921	269
	Ksi Kswan	27-Aug-2023	1,800	89	1,127	1,468	40
	(Kshwan River)	08-Sep-2023	1,800	92	213	224	43
		19-Sep-2023	1,800	89	129	144	39
Portland Canal	Ksi Xmaat'in	10-Aug-2023	1,500	100	94,530	95,485	132
	(Dogfish Creek)	23-Aug-2023	3,000	100	278,910	278,910	3,955
Lower Nass	Ksemamaith Creek	12-Aug-2023	700	95	1,460	1,537	30
	Gitzyon Creek	12-Aug-2023	1,000	90	399	443	0

Table C-2. Best escapement estimates for Pink Salmon runs observed during surveys in the Nass Area, 2023.

		Pink escapement estimate[a]	
Area	**Stream name**	**AUC[b]**	**Peak count x 2[c]**
Observatory Inlet	Ksi Xts'at'kw (Stagoo Creek)	34,442	29,875
	Illiance River	12,166	8,105
	Wilauks Creek	NA	8,889
	Dak River	NA	4,112
	Ksi Kswan (Kshwan River)[d]	NA	2,977
Portland Canal	Ksi Xmaat'in (Dogfish Creek)	NA	281,443[e]
Lower Nass	Ksemamaith Creek	NA	3,004
	Gitzyon Creek	NA	886

[a] NA = not available due to insufficient counts.

[b] Residence time (RT) and standard deviation (SD) for Pink Salmon estimates: RT = 12.6 d; SD = 4.0 d; from Perrine and Irvine (1990)

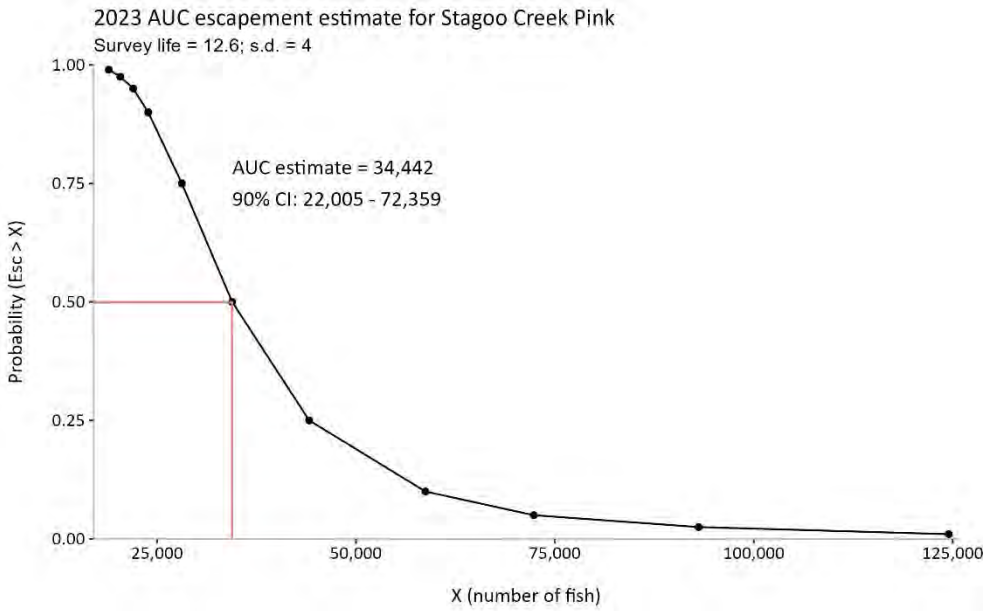
90% CI: Ksi Xts'at'kw (Stagoo Creek) = 22,005−72,359; Illiance River = 7,732−25,558

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

[d] Ksi Kswan estimates are based on counts from side-channels and unnamed tributaries of Ksi Kswan.

[e] Peak count x 2 estimate was reduced by 50% (from 562,886) due to high observed pre-spawn mortality.

Ksi Xts'at'kw (Stagoo Creek)



Illiance River

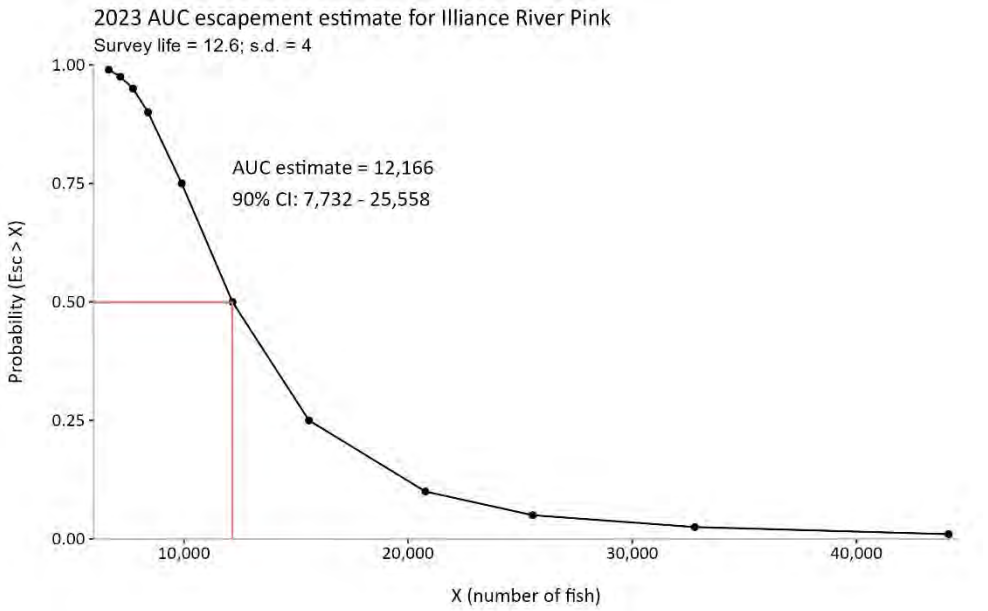


Figure C-1. Probability distributions of AUC escapement estimates for Pink Salmon streams surveyed in 2023. Probability distributions were generated using AUCmonteMASTER 2.04 and the red lines show the escapement estimate for each stream.