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Fraser River Panel Annual Report on the 2023 Fraser River Sockeye and Pink Salmon Season

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PACIFIC SALMON COMMISSION

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FRASER RIVER PANEL ANNUAL REPORT ON THE 2023 FRASER RIVER SOCKEYE AND PINK SALMON SEASON

Prepared by the

FISHERIES MANAGEMENT DIVISION

of the

PACIFIC SALMON COMMISSION

December 2024

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TABLE OF CONTENTS

Page

LIST OF TABLES ii

LIST OF FIGURES iii

I. EXECUTIVE SUMMARY 1

II. FRASER RIVER PANEL 4

III. PANEL MANAGEMENT ACTIVITIES 5
A. Pre-season Planning 6
B. In-season Management 11

IV. MANAGEMENT INFORMATION 19
A. Abundance 20
B. Migration Timing and Diversion Rate 42
C. Big Bar Landslide 42
D. Management Adjustments and DBEs 25
E. Mission Passage 25

V. RUN SIZE, CATCH AND ESCAPEMENT 28
A. Sockeye Salmon 28
B. Pink Salmon 34

VI. ACHIEVEMENT OF OBJECTIVES 36
A. Escapement 37
B. International Allocation 38
C. Domestic Allocation 40
D. Conservation of Other Stocks and Species 41

VII. ALLOCATION STATUS 41

VIII. POST-SEASON REVIEW 42

IX. APPENDICES 44
Appendix A: Glossary of Terms and Abbreviations 44
Appendix B: 2023 Pre-season Forecasts and Spawning Escapement Targets for Fraser River Sockeye and Pink Salmon 48
Appendix C: 2023 Fraser River Panel Management Plan Principles and Constraints 51
Appendix D: 2023 Regulations 53
Appendix E: 2023 Fraser River Panel In-Season Orders 55
Appendix F: PSC Staff Activities: Stock Monitoring, Identification and Assessment, and Management Adjustments 61
Appendix G: Historical Catch, Escapement and Production Data, and detailed TAC calculation 76
Appendix H: PSC review report of August 18 & 25, 2023 FRP decisions 81
Appendix I: Bilateral response to report on August 18 & 25, 2023 FRP decisions 131
Appendix J: Members of the Fraser River Panel Technical Committee in 2023 134
Appendix K: Staff of the Pacific Salmon Commission in 2023 135

LIST OF TABLES

Page

Table 1. Pre-season and in-season updates of management information 16
Table 2. Number of days when major Canadian net fisheries in the Fraser River Panel Area were open for directed harvest of Fraser River pink salmon 18
Table 3. Number of days when major U.S. net fisheries in the Fraser River Panel Area were open for directed harvest of Fraser River pink salmon 18
Table 4. Panel-approved stock monitoring operations conducted in 2023 19
Table 5. Major component stocks included in the Fraser River sockeye stock groups used in 2023 20
Table 6. Best performing pDBE approach identified by the retrospective analysis of the pre-season and in-season pDBE approach for each management group 26
Table 7. Pre-season, in-season and post-season estimates of DBEs and pMAs 26
Table 8. Fraser River sockeye and pink salmon passage at Mission in 2023 28
Table 9. Catch by major fishing area or group, escapement, DBE and run size of Fraser sockeye (by management group) and pink salmon in 2023 29
Table 10. Catch, escapement, DBE, run size and exploitation rate for Fraser sockeye (by stock group) and pink salmon in 2023 30
Table 11. Canadian commercial catches of Fraser River pink salmon by user group, gear type and statistical area in 2023 36
Table 12. U.S. commercial catches of Fraser River pink salmon by user group, gear type and statistical area in 2023 36
Table 13. Comparison of in-season targets and in-season potential spawning escapement for adult Fraser River sockeye salmon in 2023 37
Table 14. Comparison of post-season spawning escapement targets and escapement estimates for adult Fraser River sockeye and pink salmon in 2023 38
Table 15. Total allowable catch (TAC) and achievement of international catch shares for Fraser River sockeye and pink salmon in 2023 39
Table 16. Achievement of domestic catch goals in Washington for Fraser sockeye salmon 40
Table 17. Achievement of domestic catch goals in Washington for Fraser pink salmon 40
Table 18. Catches of non-Fraser sockeye and pink salmon and catches of other salmon species in commercial fisheries regulated by the Fraser River Panel in 2023 41
Table 19. Allocation status for Fraser River sockeye and pink salmon in 2019-2023 42

Appendix B

Table B1. Pre-season forecasts for Fraser River sockeye and pink salmon in 2023 48
Table B2. Spawning escapement plan for Fraser River sockeye and pink salmon in 2023 49

Appendix F

Table F1. Sampling details for Panel-approved test fisheries conducted in 2023 61
Table F2. Summary of the 2023 forecast and the in-season age composition 67
Table F3. Summary of adopted pre-season and in-season pMAs 74
Table F4. Summary of the pre-season and in-season MA models and assumptions 75

Appendix G

Table G1. Catch by user group, spawning escapement, difference between estimate and run size of Fraser River sockeye salmon for cycle years 2011-2023 76
Table G2. Catch by user group, spawning escapement and run size of Fraser River pink salmon for cycle years 2013-2023 77
Table G3. Escapements of sockeye salmon to Fraser River spawning areas for cycle years 2011-2023 78
Table G4. Fraser River pink salmon production for odd brood years in 1961-2021 79
Table G5. Detailed calculation of total allowable catch (TAC) and achievement of international catch shares for Fraser sockeye (by management group) salmon in 2023 80

LIST OF FIGURES

Page

Figure 1. Fishery management areas in the Fraser River Panel Area and south coast waters.....5
Figure 2. The northern (Johnstone Strait) and southern (Juan de Fuca Strait) routes for sockeye and pink salmon migration to the Fraser River.....7
Figure 3. Pre-season projections and post-season reconstructions of daily Fraser River sockeye salmon abundance by management group in 2023 (Area 20 date).....21
Figure 4. Pre-season projections and post-season reconstructions of daily Fraser River sockeye and pink salmon abundance in 2023 (Area 20 date).....22
Figure 5. Pre-season forecasts of annual Johnstone Strait diversion rate for Fraser sockeye and pink salmon, compared to in-season estimates of short-term and annual rates.....23
Figure 6. Big Bar site before and after landslide.....24
Figure 7. Map of Big Bar sonar, salmon capture and radio tagging locations.....24
Figure 8. Fraser River temperature and discharge measured near Hope in 2023. Also shown are the mean temperature and discharge during the 31 day period centered around the median date of the migration past Hells Gate for each management group (excluding Pitt).....27
Figure 9. Total run size of Fraser River sockeye salmon in 1893-2023. Returns on the 2023 cycle are emphasized.....31
Figure 10. Total catch, escapement, difference between estimate (DBE), run size and exploitation rate for Fraser River sockeye salmon in 1985-2023, with returns on the 2023 cycle emphasized.....32
Figure 11. Sockeye salmon spawning areas in the Fraser River watershed.....33
Figure 12. Annual adult spawning escapement of Fraser River sockeye salmon for each management group and for total sockeye in 1938-2023.....34
Figure 13. Total catch, escapement, run size and exploitation rate for Fraser River pink salmon in 1959-2023.....35

Appendix F

Figure F1. Cross river view of sampling geometry of the four sonar systems used at Mission.....64
Figure F2. Observed proportions of Canada South Coast and Fraser River pink salmon.....69
Figure F3. Daily reconstructed abundances and corresponding run-size estimates at different times during the season, for Fraser River sockeye (by management group) and pink salmon.....71

I. EXECUTIVE SUMMARY

The data presented in this report are accurate as of the time of publication. For updates and access to the data please see our Fraser River Panel (FRP) Annual Report App found at: psc1.shinyapps.io/PSC_Annual_Fraser. The following paragraphs describe the planning of the 2023 season, the in-season Panel management actions and the outcome in terms of achieving Panel objectives:

Pre-season Planning

1. Pre-season, the median run size forecast (p50 level, Appendix B) was 1,564,000 Fraser River sockeye salmon and according to the quantitative forecast there was a one in two chance that the run size would be between 800,000 and 3,185,000. The median Fraser River pink run size forecast was 6,135,000 (p50 level, Appendix B) with a one in two chance that the run size would be between 4,389,000 and 8,575,000.
2. There was a great deal of uncertainty around the survival of pink salmon eggs deposited in the Fraser Valley during the floods in the fall and winter of 2021. This additional uncertainty was not reflected in the pink salmon forecast estimates.
3. Pre-season expectations of migration parameters included a 67% diversion rate for Fraser River sockeye and a 53% diversion rate for Fraser River pink salmon through Johnstone Strait. The Panel adopted the following Area 20 50% migration dates: July 7 for Early Stuart, August 6 for Early Summer, August 17 for Summer, August 24 for Late-run sockeye, and August 25 for pink salmon.
4. At median (p50) forecast abundance levels, pre-season spawning escapement goals were 23,000 Early Stuart, 131,900 Early Summer, 1,046,600 Summer, and 188,300 Late-run sockeye for a total of 1,389,800 sockeye salmon and 5,335,000 pink salmon (Table 1). The goals for Fraser River pink salmon and for each sockeye management group were established by applying Canada's Spawning Escapement Plan (Appendix B) to their median forecasted run sizes.
5. Management Adjustments (MAs) of 24,800 Early Stuart, 73,900 Early Summer, 240,700 Summer-run, and 188,300 Late-run sockeye were added to the spawning escapement targets to increase the likelihood of achieving the targets (Appendix F, Table F 3).
6. There was no projected Total Allowable Catch (TAC) of Fraser River sockeye salmon based on the median forecasted abundances and agreed deductions. However, the projected TAC of Fraser River pink salmon was 774,700 fish, of which 25.7% (199,100 pink salmon) were allocated to the U.S.
7. The Panel adopted the 2023 Management Plan Principles and Constraints and Regulations, and 2023 regulations (Appendices C, D).

In-season Management Considerations

8. The in-season marine migration timing (Figure 3) was earlier than pre-season expectations for all sockeye management groups: 5 days early for Early Stuart, 9 days early for the Early Summer run, 4 days early for the Summer run and 6 days early for the Late run. Pink salmon timing which was 8 days earlier than the expected timing (Figure 4) and one day earlier than late run timing which caused sockeye and pink salmon migrations to overlap more than expected pre-season.
9. The overall Johnstone Strait diversion rate (Figure 5) for Fraser River sockeye was 67% which was the same as the pre-season forecast. The Fraser River pink salmon diversion rate was 34%, instead of 53% which was used for pre-season planning.
10. Returns for Fraser sockeye and pink salmon were greater than the median pre-season forecast for all management groups except Summer run: Early Stuart run: 78% above median forecast, Early Summer run: 83% above median forecast, Summer run: 12% below median forecast, Late

run: 91% above median forecast and pink salmon run: 68% above median forecast. Returns for pink salmon exceeded the p75 run size forecast.

11. Throughout the season, extremely high temperatures caused migration challenges especially for Early Stuart and Early Summer run. The Panel adopted proportional Management Adjustments (pMAs) for Early Stuart and Early Summer run based on the retrospective analysis presented to the Panel in 2022 to ensure spawning escapement targets were met. No in-season changes were made to the Summer or Late run as the pre-season model was identified as the best approach based on the retrospective analysis.
12. On August 18, the U.S. proposed pink-directed Treaty Tribal Ceremonial and Subsistence (C&S) fisheries with retention of sockeye. The U.S.A. considered the incidental harvest rate of sockeye small but acceptable and in accordance with the Treaty. Canada did not approve of this fishery proposal and while acknowledging objections of Canada, the Panel approved the U.S. fisheries proposals as allowed under Chapter 4, paragraph 13(d).
13. On August 25, the U.S. proposed pink-directed Treaty Tribal and All Citizen fisheries with non-retention of sockeye and considered the fisheries induced mortality of sockeye salmon small but acceptable and in accordance with the Treaty. Canada did not approve of this fishery proposal and while acknowledging objections of Canada, the Panel approved the U.S. fisheries proposals as allowed under Chapter 4, paragraph 13(d).

Run Size, Catch, Escapement and Migration patterns

14. Estimated returns of adult Fraser sockeye totalled 1,693,000 fish (Tables 9 and 10) which was 196% greater than the run size of 571,000 fish in the primary brood year (2019). Divided into management groups, adult returns totalled 41,200 Early Stuart, 334,700 Early Summer-run, 966,000 Summer-run and 350,900 Late-run sockeye.
15. All Fraser River sockeye management groups remained in a low abundance exploitation rate (LAER) while for pink salmon the increase in run size resulted in an increase in international total allowable catch (TAC).
16. Catches of Fraser River sockeye salmon in all fisheries totalled 47,700 fish, including 28,700 fish caught by Canada, 2,400 fish caught by the U.S. (Washington) and 16,700 fish caught by test fisheries (Table 9). The Canadian catch was a mix of First Nations Catch, 1,200 and non-commercial catch, 27,500, which included ‘other’ catch (22,500; unauthorized directed retention or unauthorized bycatch retention in fisheries directed at other species). In Washington, there was an ‘other’ catch of 200 sockeye in the U.S. Treaty Tribe pink directed fishery. The preliminary estimate of Alaska District 104 sockeye catch is 7,775. The overall exploitation rate of Fraser River sockeye salmon was 2.8% of the run, which excludes Alaska District 104 catch (Figure 10). This sockeye exploitation rate is the lowest on record.
17. In addition to the reported catches, it is estimated the associated sockeye mortality following release from pink directed fisheries was 6,470 sockeye, with 5,630 attributed to Canadian fisheries and 840 attributed to Washington fisheries. Including the fishing induced mortalities (FIMs), the overall exploitation rate of Fraser River sockeye salmon was 3.2%.
18. DFO’s near-final estimates of spawning escapements to streams in the Fraser River watershed totalled 918,200 adult sockeye and were below cycle line averages for all run timing groups except Early Summer (Tables 9 and 10, Figure 12). This was three times greater than the Fraser sockeye 2019 brood year escapement of 304,600 adults, which was impacted by the Big Bar landslide. In 2023, there were 524,900 effective female spawners in the Fraser watershed and overall spawning success was 96%.
19. The total run-size estimate of Fraser River pink salmon was 10,513,300 (Figure 13), calculated by adding the total catch of pink salmon below Mission (934,300 fish) to the Mission passage estimate (9,578,600 fish, Table 8).
20. Fraser pink salmon catches totalled 971,300 fish, with 528,100 caught by Canada, of which 443,000 were caught in commercial fisheries, 76,600 were caught in recreational fisheries and 7,800 were caught in First Nations FSC and EO fisheries (Table 9). For the U.S., there was a total catch of 428,900 of which 428,700 was caught in commercial fisheries (Table 12). The remaining 14,300 were caught in test fisheries (Table 9). This total Fraser pink salmon catch

represents an exploitation rate of 9% (Table 9 and 10), which is well below average since records began in 1959 (Figure 13).

21. The pink salmon spawner escapement (9,542,000 fish) was calculated by subtracting the total catch from the run size.

Achievement of Objectives

22. In order of descending priority, the goals of the Panel are to achieve the targets for spawning escapement, international sharing of the TAC, and domestic catch allocation.
23. In-season management decisions are based on targets for spawning escapement, which are represented in-season by potential spawning escapement targets (i.e., spawning escapement targets plus MAs). The Panel adopted larger MAs in-season to ensure the spawning escapement targets were met for Early Stuart and Early Summer run, while the pre-season MAs for Summer and Late run were not changed in-season as the pre-season MAs methods for these management groups were identified as the best in-season approach in low discharge years. Due to the low return, the spawning escapement targets for Early Stuart and Summer run equalled their run sizes. Also, with the very low catches, the potential escapements (i.e., Mission escapement minus all catch above Mission) for all management groups were very similar to the spawning escapement targets, 2% under for Early Stuart, 2% over for Early Summer run, and 3% under for Summer and Late run (Table 13).
24. For Early Stuart, Summer, and Late-run management groups, the spawning escapement target either equalled the run size or were very close to the run size, so the escapement target could only be obtained in the absence of catches *and* any difference between estimates. Thus even with the rigorous management approach that was applied in 2023, spawning escapement targets could not be met for these three groups given the challenging migration conditions encountered in 2023 (Table 14). The Early Summer run management group exceeded its spawning escapement target by 11% due to Nadina sockeye which returned in greater numbers than expected and accounted for 60% of the Early Summer-run escapement. All other Early Summer run stocks returned below the post-season target.
25. Spawning ground estimates of Fraser sockeye abundance totalled 918,200 adults, which is 38% less than the post-season target. Spawner abundance was below target for Early Stuart sockeye (75% under), above target for Early Summer-run (11% over), below target for Summer-run (39% under) and below target for Late-run sockeye (57% under) (Table 14). The exploitation rates for all management groups were less than their respective LAERs.
26. There was no available international TAC of Fraser sockeye (Table 15) based on the calculation method set out in Annex IV, Chapter 4 of the Pacific Salmon Treaty. Both countries reported ‘other’ sockeye catch (unauthorized directed retention or unauthorized bycatch retention in fisheries directed at other species). The total Canadian catch of 24,500 Fraser sockeye (excluding ESSR catch) consisted mostly of ‘other’ catch as well as 1,200 First Nations catch and 700 fish caught in the Charter test fisheries (Albion). This Canadian catch exceeded the Canadian share of TAC + Aboriginal Fisheries Exemption (AFE). In these calculations, the TAC is based on the TAC on the date of the last in-season Panel meeting (September 27, 2023), while catches are post-season estimates.
27. The U.S. exceeded their Fraser sockeye TAC by 2,400 fish (Table 15). In terms of domestic U.S. allocation objectives for Fraser sockeye, U.S. Treaty Tribe fishers exceeded their share of the U.S. TAC by 2,200 fish (Table 16).
28. For Fraser River pink salmon, there was a TAC of 4,285,700 salmon (Table 15) based on the calculation method set out in Annex IV, Chapter 4 of the Pacific Salmon Treaty.
29. Access to pink salmon TAC was limited by a lack of TAC for sockeye salmon. In Canada, pink salmon directed fisheries were also impacted by the comigrating sockeye stocks that were in a LAER. As a result the spawning escapement for Fraser River pink salmon was greater than the post-season target (59% over; Table 14) and the exploitation rate was low at 9% (Table 9).
30. The Washington catch of 428,900 Fraser pink salmon was less than their 25.7% share of the international TAC and the Canadian catch of 528,100 was less than their allowable catch of 3,184,300.

31. Regarding domestic U.S. allocation objectives for Fraser pink salmon, both U.S. Treaty Tribe and All Citizen fisheries catches were below their shares of the U.S. TAC (Table 17), by 227,500 fish and 445,000 fish, respectively.
32. There was no reported bycatch of non-Fraser sockeye salmon with the exception of 542 non-Fraser sockeye caught by the test fisheries, but there was a bycatch of 211,100 non-Fraser pink salmon in commercial net fisheries regulated by the Fraser River Panel (Table 18). Catches of other Fraser and non-Fraser salmon species included 9,570 Chinook, 3,380 coho, 10 chum, and zero steelhead.

Allocation Status

33. By Panel agreement there is a U.S. payback of 2,390 Fraser River sockeye (Table 19). There was no payback owed for Fraser River pink salmon (Table 19).

Post-season Review (Appendix H and I)

34. On August 18, 2023 and August 25, 2023, the United States prosecuted pink directed fisheries that Canada objected to under the provisions of Annex IV, Chapter 4, paragraph 13(d)(iii).
35. Pursuant to the same paragraph, the United States provided a rationale for these two fisheries via correspondence to the panel's Canadian chair on August 19, 2023 and August 26, 2023.
36. On October 6, 2023, Canada corresponded with the PSC Executive Secretary, requesting an objective report on the circumstances of these two fisheries and its consequences pursuant to Chapter 4, paragraph 13(e).
37. A report prepared by PSC staff was submitted to the Panel December 20, 2023 and reviewed at the PSC January post-season meeting. The report contained 12 recommendations to be considered by the Fraser Panel.
38. The response to the report by the Panel provided a summary of the disagreement and next steps which included a workplan by June 2024 to address the recommendations set forth in the document.

II. FRASER RIVER PANEL

In 2023, the Panel operated under the terms of Annex IV, Chapter 4 of the Pacific Salmon Treaty between Canada and the United States (U.S.).[1] The Fraser River Panel was responsible for in-season management of fisheries that target Fraser River sockeye and pink salmon within the Panel Area (Figure 1), including commercial net fisheries in both countries and the Canadian troll fishery in the Strait of Georgia. Fisheries directed at Fraser River sockeye and pink salmon that occur outside of the Panel Area are coordinated with those in the Panel Area, but are the responsibility of the appropriate agencies, largely Canada's Department of Fisheries and Oceans (DFO). Coordination of directed harvest of other salmon species (coho and chum) intercepted south of Cape Caution is the responsibility of the Southern Panel and the Pacific Salmon Commission (PSC). Regulation of Southern Panel related fisheries is the responsibility of the appropriate agencies in each country.

Prior to the fishing season, the Fraser River Panel recommends a fishery regime for Panel Area fisheries to the Pacific Salmon Commission (PSC). The recommendation is based on: (1) abundance, timing and migration route forecasts and escapement targets for Fraser River sockeye and pink salmon provided by Canada's Department of Fisheries and Oceans (DFO); (2) international catch allocation goals set by the Treaty; (3) domestic catch allocation goals established by each country; (4) management concerns for other stocks and species also identified by each country; and (5) historical patterns in migration and fisheries dynamics. In descending priority, the objectives that guide the Panel's decision-making are to: (1) achieve the spawning escapement targets, (2) meet international catch allocation goals, and (3) meet domestic catch allocation objectives. Conservation concerns for other species and stocks that may occur as bycatch in fisheries directed at Fraser River

[1] Pacific Salmon Treaty as modified through January 2020.

sockeye and pink salmon are generally addressed domestically with some international coordination. While not under Panel regulatory control, management of Canadian non-Panel area fisheries directed at Fraser River sockeye and pink salmon is based on the same in-season information and hierarchy of objectives.

The Panel's regulatory authority is implemented based on the principle that all Panel-regulated fisheries are to remain closed (Appendix D) unless opened by specific order (Appendix E). The pre-season plan identifies the approximate pattern of fishery openings required to achieve the Panel objectives given pre-season expectations. However, the Panel typically determines the actual pattern of fishery openings based on in-season assessments by PSC Staff (hereinafter "Staff", Appendix K) of Fraser sockeye and pink salmon run size, migration timing and route, in-river migration abundance (i.e., Mission escapement) and Management Adjustments. Thus, the Panel responds to deviations from pre-season expectations in their weekly fishing plans and most substantive fishery decisions are based on in-season rather than pre-season assessments. The Fraser River Panel Technical Committee (Appendix J) works in conjunction with Staff to facilitate Panel activities by providing their respective National Sections of the Panel with technical advice and ensuring timely exchange of data between Staff and the Parties.

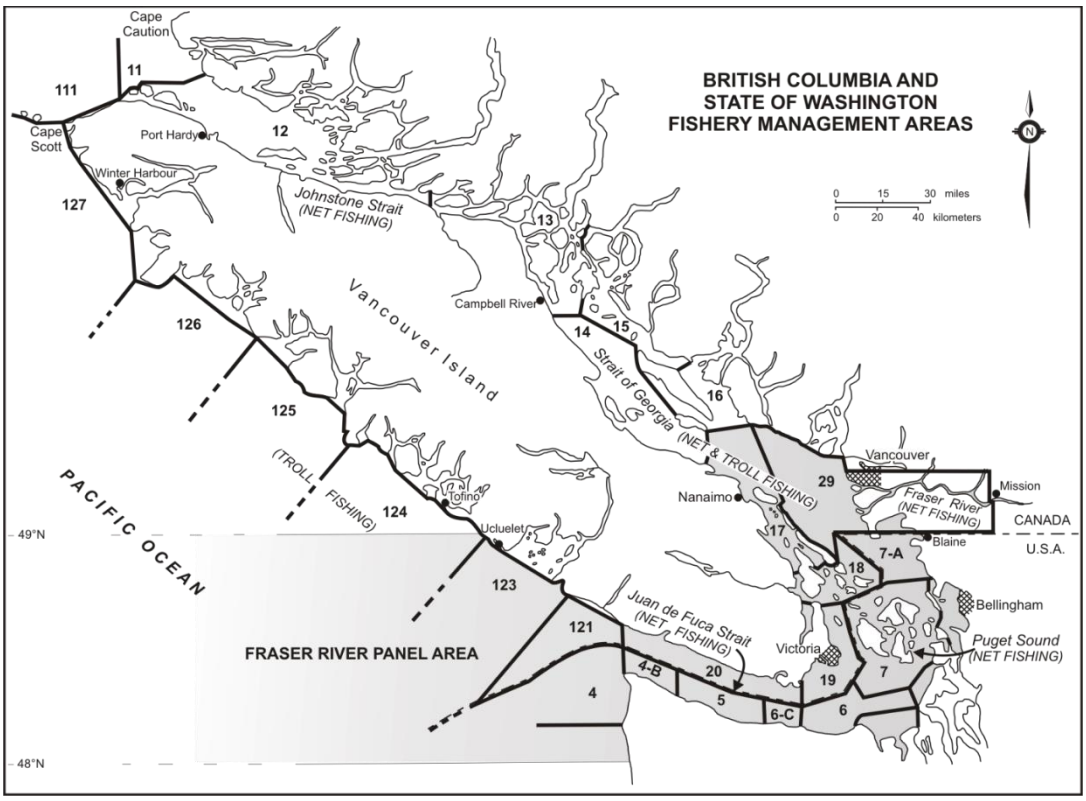

Figure 1. Fishery management areas in the Fraser River Panel Area and south coast waters.

III. PANEL MANAGEMENT ACTIVITIES

Information used for Panel management can be divided into three general categories: (1) pre-season forecasts and expectations, on which planning activities such as the pre-season management plan are based; (2) in-season estimates that change over the course of the season, on which in-season fishery decisions are based; and (3) post-season estimates derived from information that was unavailable during the season, such as spawning ground estimates of escapement, more complete

catch estimates, and adjustments to estimates that with hindsight appear to have been biased or incorrect. Post-season estimates impact Panel management in two ways: (a) they can affect the data used to inform pre-season assumptions in future years (e.g. abundance, timing and management adjustments) and (b) some elements (e.g. spawning escapements, catches) impact post-season evaluation of the achievement of management objectives (see Section VI below for more details). Key information in the first two categories is discussed in the following sections.

A. Pre-season Planning

Pre-season fisheries management plans for Fraser sockeye and pink salmon directed fisheries were developed by the Panel using the Fishery Planning Model[2], which allows the evaluation of the impacts of alternative fishery options on the achievement of management objectives. Model inputs include forecasts of run size, migration timing, diversion rate, migration delays in the Strait of Georgia, and management adjustments (MAs), test fishery deductions, as well as objectives for spawning escapement and catch allocation.

The preliminary run-size forecast for Fraser River sockeye salmon was produced by Canada using a variety of stock-recruit models with data up until the 2019 brood year (2020 brood year for Harrison).[3] A larger suite of sockeye forecast models was considered and an updated retrospective analysis had been conducted by DFO. Canada presented the Panel with a run-size forecasts for both species corresponding to five probability levels (10%, 25%, 50%, 75% and 90%) (Appendix B, Table B1). The median forecast (50th percentile, or p50) represented an equal chance (i.e., a one in two chance) that the return would fall below the forecast value. For planning purposes, the Panel used the median (i.e., p50) run size forecast of 1.56 million Fraser River sockeye salmon and the median run size forecast of 6.1 million Fraser River pink salmon as the "base case" scenario. The Panel also explored an alternative sockeye abundance scenario for planning purposes, assuming a run size corresponding to the p75 of the distribution of the forecasted run size (p75: 3.2 million) as well as two alternative pink salmon run size scenarios of 8.6 million (i.e., p75) and 10.5 million (between the p75 and p90).

Pre-season fisheries management planning was based on assumptions about the proportions of Fraser River sockeye and pink salmon migrating through Johnstone Strait instead of Juan de Fuca Strait (i.e., Johnstone Strait diversion rate, Figure 2) as well as marine timing (i.e., 50% migration dates). Area 20 dates are indices of marine migration timing and represent the date when 50% of the total run would have entered Juan de Fuca Strait (Canadian Area 20) if the entire run had migrated via that route. DFOs oceanographic models generated timing forecasts of July 10 for the Early Stuart run and August 17 for the Chilko run.[4] The timing forecast of July 10 for the Early Stuart run was considered extreme as it was later than the 90th percentile of the historical median timing. Therefore, the Panel adopted for pre-season planning an Early Stuart run timing of July 7, which corresponded with the 90th percentile of the historical median timing for this stock. The difference between the Chilko historical median of August 10 (for all years excluding the 2020 cycle line years) compared to the adopted Chilko timing of August 17 (+7 days) was used to offset the assumed timing for all other component stock groups within the Planning Model. This offset generated predicted timings for some stocks that were also considered extreme as they were later than the 90th percentile of the historical median timing. For these stocks, the 90th percentile of the historical median was also used for the Planning Model. Historical median timing for each management group was derived based on

[2] Hague, M.J. 2022. Assessment of Fisheries Plans. In: Michielsens, C.G.J. and Martens, F.J. Editors. Overview of pre-season and in-season assessment methods for Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 49, 38-64 p.

[3] Dionne, K. and Liu, Q. 2024. Pre-season run size forecasts for Fraser River Sockeye Salmon (*Oncorhynchus nerka*) and Pink Salmon (*Oncorhynchus gorbuscha*) in 2023. Can. Tech. Advis. Rep. Fish. Aquat. Sci. 3634: iv +120 p.

[4] Folkes, M.J.P., Thomson, R.E., and Hourston, R.A.S. 2018. Evaluating Models to Forecast Return Timing and Diversion Rate of Fraser Sockeye Salmon. DFO Can. Sci. Advis. Sec. Res. Doc. 2017/021. vi + 220 p.

the aggregated daily abundance of component stocks assuming normal run timing distributions. The Panel adopted the resulting historical timing estimates of July 7 for the Early Stuart run, August 6 for the Early Summer run, August 17 for the Summer run and August 24 for the Late run. DFO also produced a median Area 20 timing forecast for Fraser River pink salmon of August 25, one day later than the median timing during the period of 1999-2021. The timing of August 24 was adopted by the Panel and there was additional pre-season modelling performed assuming an earlier timing of August 17. There was a great deal of uncertainty around the survival of pink salmon eggs deposited in the Fraser Valley during the floods in the fall and winter of 2021. There were concerns that poor survival of these later returning populations may result in an earlier overall pink salmon return and this alternative timing was used to explore the potential impact on earlier timed pink salmon directed fisheries on co-migrating sockeye stocks. Figure 3 illustrates the distribution of daily abundances by management group given the pre-season assumptions of Area 20 timing and total run size.

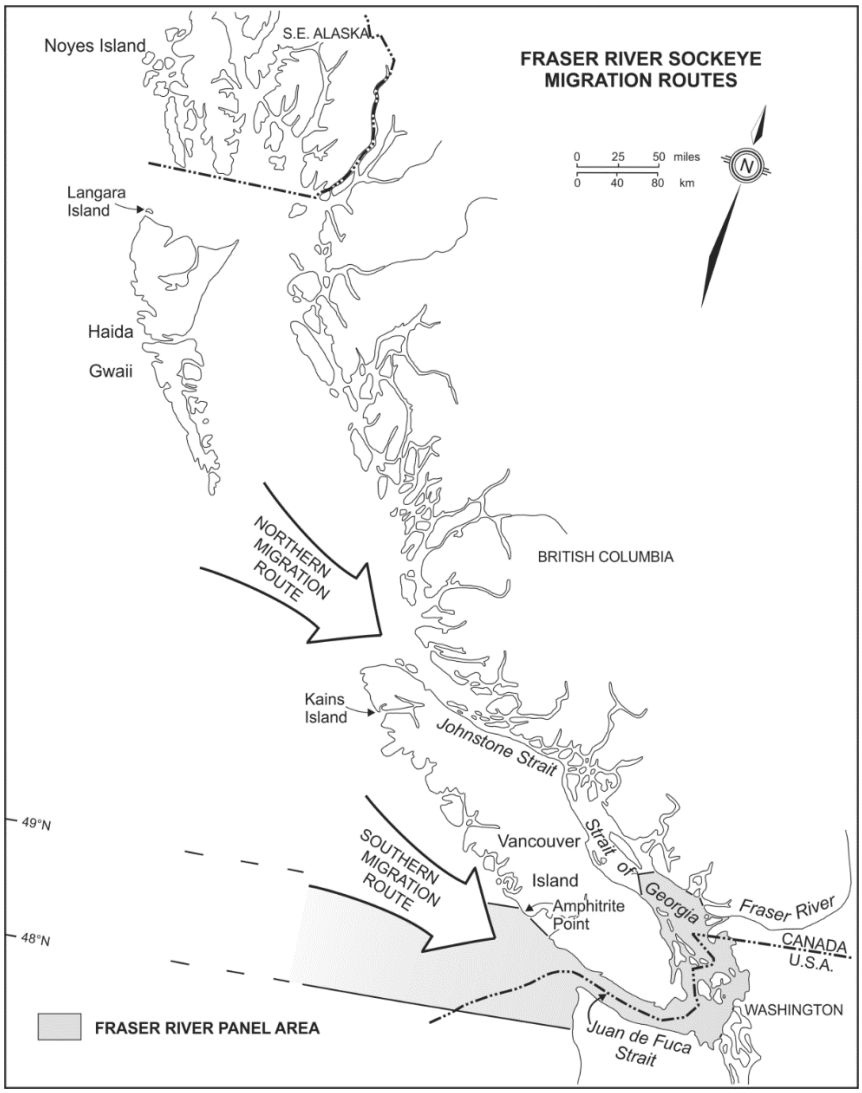

Figure 2. The northern (Johnstone Strait) and southern (Juan de Fuca Strait) routes for sockeye and pink salmon migration to the Fraser River.

The pre-season diversion rates of 67% for Fraser River sockeye and 53% for Fraser River pink salmon were derived by DFO using a combination of current velocities and sea surface temperatures.[5] The Panel adopted these diversion rates and modelled an alternative run assuming a historical sockeye diversion rate of 75% to assess how a more northern sockeye diversion would affect the ability for the U.S. to prosecute pink salmon fisheries.

Pre-season, the Panel assumed a component of the Late-run and Summer-run management groups would delay their migration into the Fraser River. There has been some evidence of increasing delay in recent years. The model assumed a 12-day delay for the Late-run, equivalent to the median delay on this cycle-line across all years. For planning purposes, the model assumed 67% of the non-Birkenhead Late-run group would delay in the Strait of Georgia and would migrate upstream around September 12. For the overall Late run group, this resulted in 50% of the run migrating upstream by September 08 and corresponded to a 20-day migration delay assuming an 8-day migration time between Area 20 and Mission without holding. The model also assumed 44% of Harrison sockeye salmon would delay in the Strait of Georgia prior to migrating upstream around September 12, the same upstream peak migration timing as the delaying Late-run stocks. For the entire Harrison stock group, this resulted in an August 16 Mission 50% date and assumed 20-days of migration delay. Although a proportion of Fraser River pink salmon are expected to delay their migration into the Fraser River, this delay behaviour is not dynamically modelled during pre-season planning.

DFO's Environmental Watch (E-Watch) Program provided the Panel with long-range (3-month) projections of Fraser River temperature and discharge. The Fraser River basin snow water index was at 88% of normal on May 1. By June 15, the basin snow water index had decreased to an average of 4% of normal across the province. The exceptionally rapid and early snowmelt contributed to the high risk of a province-wide drought in the summer.[5] The long-range forecast predicted below average discharge for the summer period and above average lower river temperatures throughout the summer. The environmental forecast was used to inform environmental Management Adjustment (MA) models to forecast the pDBEs (see Table F3). From this, a prediction can be made as to how many additional sockeye should be allowed to escape to achieve spawning escapement objectives.[6] Due to the below average discharge, there was little concern regarding sockeye migration challenges at the Big Bar slide.

For 2023, the Panel chose to adopt the proportional management adjustments (pMAs) (see Table 6) based on the best pDBE forecast method identified by the retrospective analysis of the pre-season pDBE approaches (see Table 6 and Appendix F). Given the low forecasted relative abundances of Pitt and Chilliwack fish in the Early Summer-run aggregate and Harrison/Widgeon fish in the Summer-run aggregate, the weighted pDBE approach had almost no impact on the aggregate for these two run timing groups. As a result, the Panel agreed to forego the weighted pDBE approach for these two run timing groups for 2023 (with possible review in-season if component proportions were different than the pre-season forecast). However, Birkenhead/Big Silver was forecasted to make up almost 50% of the Late-run aggregate and the Panel agreed to use the weighted pDBE approach for this group. The Panel adopted a pMA for the Early Stuart run (pMA=1.08; MA=24,800 fish), Early Summer-run aggregate (pMA=0.56; MA=73,900 fish), Summer run aggregate (pMA=0.23; MA=240,700 fish) and Late-run aggregate (pMA=1.00; MA=188,300 fish) (Table 7).

As 2023 was expected to have a low returning abundance of Fraser River sockeye, some test fisheries intended to supplement the core assessment program were not scheduled. These were the

[5] BC Ministry of Forests River Forecast Centre. 2023. Snow Survey and Water Supply Bulletin. https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/drought-flooding-dikes-dams/river-forecast-centre/snow-survey-water-supply-bulletin

[6] Forrest, M.R. and Hague, M.J. 2022. Fraser River sockeye management adjustments. In: Michielsens, C.G.J. and Martens, F.J. Editors. Overview of pre-season and in-season assessment methods for Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 49, 24-28p

Area 13 purse seine, the Area 4B, 5 gill net, and the Gulf troll in Area 29. An experimental gill net test fishery in the lower Fraser River was continued for the third year in 2023 at the Brownsville Bar site and operated from mid-July to mid-August with costs covered by the Southern Endowment Fund (SEF).[7] The PSC's Test Fishing Policy and associated Financial Regulation in the PSC By-Laws provided guidelines around retention policy and the resulting accounting of deficits and surpluses incurred by the test fishing program.[8,9] Approximately one-quarter of the cost of the proposed test fisheries (a total program cost of $ 1,258,000), was anticipated to be covered by non-discretionary catches (i.e., those unavoidably killed in gill net test fisheries or those retained for sampling purposes). The remaining test fishing expenses would be paid through the retention of pay fish if in-season circumstances permitted, and the Test Fishing Revolving Fund would only be used if sufficient pay fish could not be retained.

The total non-discretionary catch for Fraser River sockeye (16,900) and pink (4,800) salmon were estimated using the historical relationship between non-discretionary catch and sockeye run size. The distribution of this catch across management groups was based on the average proportions of the non-discretionary catch observed over the last 3-years on the cycle line. It was anticipated that an additional 20,500 Fraser pink salmon could be retained as pay fish in the test fisheries.

During the pre-season planning process, both countries identified salmon stocks with conservation concerns that could influence management decisions for fisheries directed at Fraser River sockeye and pink salmon. Canada identified Cultus Lake sockeye salmon and other weak Fraser stocks recently assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)[10], Sakinaw and other sockeye salmon stocks returning to rivers and inlets in Johnstone Strait, interior Fraser River coho salmon, interior Fraser steelhead salmon, all Fraser River Chinook salmon except the Summer 4-1's, west coast Vancouver Island and Strait of Georgia wild Chinook salmon, and the Southern Resident Killer whale population. The U.S. highlighted concerns for Puget Sound Chinook, coho salmon, chum and steelhead salmon, Hood Canal summer chum salmon, and the Southern Resident Killer whale population.

Canada used the "Fraser River Sockeye Spawning Initiative" (FRSSI) model in combination with pre-season stakeholder consultations to establish escapement goals for 2023. These are documented in the Pacific Region Integrated Fisheries Management Plan (IFMP).[11] The spawning escapement plan released by Canada to the Panel (Appendix B, Table B2) relies on the application of a Total Allowable Mortality (TAM) rule, defined by a Lower Fishery Reference Point, an Upper Fishery Reference Point, a TAM cap, and a Low Abundance Exploitation rate (LAER). The LAER is applied to accommodate "small but acceptable" amounts of by-catch for management groups, or species, with little or no total allowable catch (TAC). Taking into account the management adjustments, the resulting pre-season escapement targets for sockeye at the p50 run size levels by management group were: Early Stuart – 23,000; Early Summer run – 186,010; Summer run– 1,166,900; and Late run – 188,300. Because the escapement targets were equivalent to the forecasted run size, all management groups were managed at a LAER to allow harvest on co-migrating salmon (10% for all management groups) and there was no directed sockeye harvest planned under the base case scenario. The pre-season escapement target for pink salmon at the p50 run size level was 5,335,000.

[7] Sutherland, T., Baltzell, M., Jantz, L., and A. Fisher. 2024. Lower Fraser River Gillnet Test Fishery Site Evaluation. SEF Final Report.
[8] Pacific Salmon Commission Test Fishing Policy. Feb. 10, 2021. Pacific Salmon Commission
[9] Rule 25: Test Fishing Revolving Fund. Pacific Salmon Commission. PSC Bylaws: Chapter IX
[10]Huang, A-M., Pestal, G., Guthrie, I. 2021. Recovery Potential Assessment for Fraser River Sockeye Salmon (Oncorhynchus nerka) – Nine Designatable Units: Probability of Achieving Recovery Targets - Elements 12, 13, 15, 19-22. DFO Can. Sci. Advis. Sec. Res. Doc. 2021/043. x + 96.
[11] Fisheries and Oceans Canada. 2023. Southern Salmon Integrated Fisheries Management Plan 2023/2024. 23-2280: 639p.

Calculations of TACs and international harvest shares for Fraser sockeye and pink salmon were based on Annex IV, Chapter 4 of the Pacific Salmon Treaty.[12] There was no pre-season Fraser River sockeye TAC for international sharing. The pre-season pink salmon TAC for international sharing was 774,700 (Table 1), of which the 25.4% U.S. (Washington) share was 199,100 fish. Treaty Tribes fisheries were allocated 50% of the U.S. TAC and All Citizen fisheries were allocated the remaining 50%. The remaining TAC balance was 575,600 pink salmon available for harvest by Canada. Commercial pre-season catch targets in Canada totalled 435,600 pink salmon of which the Area B purse seine fleet was allocated 89.2% and Area H troll fleet allocated the remaining 10.8%. Canadian non-commercial catch targets totalled 140,000, including 101,100 fish for in-river First Nations and 43,000 fish for marine First Nations. There was no projected recreational catch of Fraser pink salmon.

Canada and the U.S. developed a pre-season management plan under the "base case" conditions which included the "2023 Management Plan Principles and Constraints" and "2023 Regulations" (Appendices C & D) and evaluated fishing plans directed at catching Fraser River sockeye and pink salmon. Assuming the median run size estimate (p50 or 50th percentile) for both species, there was no available harvest and directed fisheries targeting sockeye salmon. Pink fishery impacts by Canada and the U.S. were constrained by both 10% low abundance exploitation rates (LAERs) assigned to all Fraser sockeye management groups, and by the limited pink salmon TAC. Canada was able to achieve their full pink salmon TAC largely due to the planning of fisheries occurring in the Strait of Georgia and lower Fraser River, fisheries not dynamically modelled within the fishery simulation framework. The Canadian fishing plan resulted in a modelled Fraser pink salmon catch of 568,500, or 98.8% of the 575,600 available for harvest. These Canadian pink fisheries resulted in an estimated 6,900 fishery induced mortalities (FIMs) of Fraser sockeye salmon. The U.S. was able to achieve a catch of 198,400 of its allocated share of 199,100 pink salmon TAC by scheduling pink salmon directed fisheries in late August and early September. U.S. Treaty Tribes fisheries were planned with a retention of approximately 5,300 Fraser River sockeye while All Citizen fishing plans generated an estimated mortality of approximately 1,000 Fraser River sockeye as FIMs for a total mortality in U.S. fisheries of 6,400 Fraser sockeye. During pre-season modelling, FIMs were included in estimates of exploitation rate, but excluded from total catch estimates (i.e., not counted against the TAC but used to assess performance relative to the LAERs). The Area 4B,5,6C Treaty Tribes fisheries were the first potential fisheries directed at Fraser River pink salmon commencing on August 21 and operating until August 31. The first Canadian marine FSC fisheries commenced on August 23 in Johnstone Strait. Fishery openings during earlier dates in the pre-season plan were constrained by a 10% LAER for Early Stuart and Early Summer run sockeye, a moving window closure for fisheries directed at Early Stuart and early timed Early Summer run sockeye, as well as area closures to protect Nimpkish sockeye and gear and timing restrictions to protect Sakinaw sockeye.

Alternative model runs explored the sensitivity of fishing plans to salmon run size. One alternative assumed sockeye and pink salmon run sizes at the pre-season p75 abundance; this permitted larger pink catches by both countries due to increased pink salmon TAC as well as available sockeye TAC. Under this p75 abundance scenario, 95,600 sockeye were retained in directed commercial fisheries in the U.S. No Canadian commercial or recreational fisheries were planned but 886,600 Fraser sockeye were expected to be caught in First Nations fisheries and 10,000 Fraser sockeye were estimated to be accounted for as FIMs. The second alternative scenario increased the pink salmon run size to 10.5 million but maintained the median run size for sockeye salmon. At a pink salmon run size of 10.5 million, both countries were able to catch close to their full pink salmon TAC but U.S. impacts on Fraser sockeye increased to 16,800 landed in the Treaty Tribes fishery and 3,400 accounted for as FIMs in the All-Citizen fishery. Additional model scenarios were developed to evaluate the sensitivity of fishing plans to different biological and

[12] Treaty Between the Government of Canada and the Government of the United States of America Concerning Pacific Salmon. (https://www.psc.org/publications/pacific-salmon-treaty/)

management inputs. These included an early pink salmon timing of August 17, the “base-case” without any sockeye retention allowed, and a sockeye diversion rate of 75%.

B. In-season Management

In 2023, returns for Fraser River sockeye and pink salmon were greater than the median pre-season forecasts, except for Summer run. Returns for pink salmon exceeded the p75 run size forecast. Marine timing was earlier than forecast for all sockeye management groups (Figure 3) as well as for pink salmon (Figure 4).

The Fraser River Panel convened 19 times between July 14, 2023 and September 27, 2023 to discuss run status and enact in-season orders (Appendix E) to regulate fisheries directed at Fraser River sockeye and pink salmon harvest in Panel Areas. Table 1 summarizes pre-season and in-season estimates by management group and by meeting date, including estimates of run size and the various deductions that result in the calculated TAC (i.e., spawning escapement target, MA, projected test fishery catch and Aboriginal Fishery Exemption). Also shown are estimates of available harvest (run size minus spawning escapement target and MA), catch to date, Mission escapement to date and 50% migration dates. The main events of the season are summarized below. Much of the corresponding in-season data are shown in Table 1.

July 9 - 15, 2023:

The first in-season Panel meeting took place on Friday, July 14. In-river test fisheries started June 26 and July 12 at Whonnock and Brownsville Bar, respectively. Marine gill net test fisheries started July 10 and 11 in Area 20 and Area 12, respectively. Due to the above average air temperatures, snowpack levels were lower than average resulting in much lower discharge levels for the time of year. On July 13, the Fraser River water discharge at Hope was about 2,682, which was approximately 52% lower than average for this date and the temperature was 3.1˚C greater than average at 19.6˚C. Hydroacoustic estimates commenced July 1 at Mission and in-season abundance estimates for Early Stuart sockeye indicated returns would be above the pre-season median run size forecast (23,000) but below the p75 forecast level (46,000) given that 24,900 Early Stuart sockeye had been accounted for in catch plus escapement by July 13. The Qualark hydroacoustics program started July 2. The estimated escapement plus catch of Early Summer-run sockeye past Mission was 20,500 but only the early-timed Early Summer-run stocks (Chilliwack, Pitt, Nadina/Bowron) were represented in the catches.

Reports from Big Bar indicated that salmon were migrating successfully through the Big Bar slide area. At the Matsqui fishwheel, 74 tags had been applied to sockeye and 20 Early Stuart sockeye had been collected for broodstock.

July 16 – 22, 2023:

Approximately 36,500 Early Stuart sockeye had passed by Mission on July 20 and migration of this stock through marine approach areas was winding down. Early Stuart abundances were exceeding the p50 forecast level of 23,000 sockeye but fell below the p75 forecast level of 46,000. The implied productivity for age-5 fish, which was the predominant age of returning Early Stuart fish this year, was slightly above average. The resulting run size was still very low compared to other years on this cycle line and substantially below the run size needed to achieve the escapement target of 108,000 which would trigger consideration of directed fisheries. The estimated escapement of Early Summer-run sockeye past Mission through July was 61,400 sockeye. The Early Summer run was dominated by Chilliwack and Nadina which are earlier stock components of this run. The marine migration timing of both the Early Stuart and the Chilliwack component seemed much earlier than predicted preseason and one of the earliest timings on the cycle line for both stocks.

Despite this better than forecast return, the upstream migration of Early Stuart sockeye was expected to be negatively impacted by the migration conditions, i.e. extremely low discharge and high temperatures. As of July 20, the Fraser River water discharge at Hope was 2479 cms, which is 50% lower than average for this date. The water temperature at Hope was 19.0˚C, which is 1.8˚C higher than average for this date. At Big Bar, the discharge was also below average and reports indicated good passage of salmon.

July 23 – 29, 2023:

Approximately 39,900 Early Stuart sockeye had been accounted for in catch plus escapement past Mission. At the Panel meeting on Friday, they adopted an Early Stuart run size of 43,000 with an associated Area 20 timing of July 2. In addition, a proportional Management Adjustment of 1.70 was adopted for Early Stuart sockeye, indicating current environmental conditions of record low water levels and high temperature could negatively impact successful Early Stuart migration to the spawning grounds to a larger extent than average. The estimated catch plus escapement for Early Summer-run, Summer-run and Late-run sockeye as of July 27 was 131,800, 12,800 and 300 fish respectively. The Early Summer run was dominated by Nadina and Chilliwack and abundances to date exceeded preseason expectations.

As of July 27, the Fraser River water discharge at Hope was 2447 cms, which was 47% lower than average for this date. The water temperature at Qualark was 19.6˚C, which was 1.5˚C higher than average for this date. A new thermistor was installed at Qualark earlier in the season and based on quality checks, the Environmental Watch program updated their data from using the Hope river temperatures to Qualark river temperatures. It was reported that the Hope reading was on average 0.5˚C cooler than the Qualark reading. This did not impact any of the management adjustment (MA) predictions as the supplemental approach was the recommended model for Early Stuart MA predictions.

At Big Bar, the discharge was also below average and reports indicated good passage of salmon. No further sonar updates were expected from Big Bar as the last day of sonar operations was scheduled for July 30 and the last tagging day in Matsqui was July 28. Monitoring of radio tagged fish would continue.

July 30 – August 5, 2023:

Approximately 262,100 Fraser sockeye had been accounted for in catch plus escapement: 41,100 Early Stuart, 184,400 Early Summers, 35,800 Summer run and 800 Late run. At the Panel meeting on Friday, they adopted an Early Summer-run run size of 240,000 with an associated Area 20 timing of July 20. In addition, PSC staff recommended an updated proportional Difference Between Estimate (pDBE) of -0.52 from -0.36, which was based on a retrospective analysis of low discharge years, and the implication for increased en route mortality in the Fraser River. While both the Canadian and U.S. section of the Panel agreed to adopt the recommended run size and timing adjustments, the U.S. did not support the adoption of the increased management adjustment (MA), and cited the poor historical performance of the model used to support the recommendation as well as the lack of international management implications (no implications for international TAC). Despite the objections by the U.S., a proportional Management Adjustment of 1.08 was adopted, given acceptance of Staff recommendations only requires agreement by one of the National Sections according to the Treaty. The adoption of the MA for Early Summer run removed any harvestable surplus for this management group.

Given the early timing for both Early Stuart and Early Summer-run sockeye, it was predicted that the timing of later timed Summer run sockeye would be earlier (Aug 6) than anticipated preseason (August 17). Assuming earlier timing, Summer run was tracking below expectations while assuming the pre-season forecasted timing of August 17,Summer-run abundances corresponded with expectations.

Similar amounts of sockeye migrated through Johnstone Strait versus Juan de Fuca Strait and the 5-day average diversion rate was 53%.

On August 3, the Fraser River water discharge at Hope was 2,234 $m^3 \cdot s^{-1}$ which was 45% lower than average for this date. The temperature of the Fraser River at Qualark was 19.7˚C which was 1.4˚C greater than average for this date.

August 6 – August 12, 2023:

The total accounted run to date was 434,100 sockeye salmon, consisting of 41,100 Early Stuart, 242,400 Early Summer-, 141,900 Summer- and 8,700 Late-run sockeye.

At the Panel meeting on Friday, the Panel adopted an Early Stuart run size of 41,000 while the associated 50% marine timing (July 2), and Management Adjustment (1.70) remained the same. They also adopted an Early Summer-run run size of 290,000 with an associated 50% marine timing in Area 20 of July 23, while no adjustment was made to the Management Adjustment (-0.52). It was still too early to make any assessments for Summer-run run size, but it appeared to be tracking below the p50 forecast level of 1,167,000, or later than assumed based on a peak migration timing of August 6, or a combination of both.

The five-day average sockeye diversion rate through Johnstone Strait was high at 74%.

Large numbers of pink salmon had been caught in the purse seine test fishery, especially in Area 12, but Fraser River pinks still made up a low proportion. Only 10 pink salmon had been caught in the in-river test fisheries. The accounted pink salmon run to date past Mission as of August 10 was 8,200.

The extreme low discharge and high temperatures was expected to negatively impact migration conditions for Fraser River sockeye. As of August 10, the Fraser River water discharge at Hope was 2,057 $m^3 \cdot s^{-1}$, which is 42% lower than average for this date and below the historical minimum. The temperature of the Fraser River at Qualark was 20.5˚C, which is 1.9˚C higher than average for this date. DFO's Environmental Watch program projected river temperature would remain high, and discharge was forecasted to decrease to 1,866 $m^3 \cdot s^{-1}$ over the next 10 days.

August 13 - 19, 2023:

In the purse seine test fisheries, strong winds had prevented the vessels from getting in their full sets, especially in Area 12. The total accounted run to date was 700,600 sockeye salmon, consisting of 41,100 Early Stuart, 296,000 Early Summer-, 341,500 Summer- and 22,000 Late-run sockeye. With the majority of sockeye migrating through the Johnstone Strait route, the current 5-day average diversion rate was 65%. Pink salmon catches in both Johnstone Strait as well as Juan de Fuca Strait had been exceptionally high this early in the season. In Juan de Fuca Strait, these catches were dominated by Fraser River pink salmon and the current 5-day average diversion rate was 34%.

At the Panel meeting on Tuesday, the Panel adopted a pink run size of 8,575,000 (reflecting the p75 forecast) with an associated 50% marine timing in Area 20 of August 18. An updated run size was also recommended for Summer run, but the Panel declined the recommendation for this management group deciding to wait until the next meeting as there were no international management implications. At the Panel meeting on Friday, the Panel adopted updated run sizes for Early Summer run, 310,000 with an associated Area 20 timing of July 24, Summer run, 800,000 with an associated Area 20 timing of August 13 and pink salmon, 17,000,000 with an associated Area 20 timing of August 13. Following the run size changes, all Fraser River sockeye management groups remained in a Low Abundance Exploitation Rate (LAER), while for pink salmon, the increase in run size resulted in an international total allowable catch (TAC) of 11 million of which 25.7% was allocated to the U.S.

On August 18, following the adoption of the run size estimates, the U.S. proposed a pink directed Treaty Tribal fishery in Areas 4B, 5, and 6C, and a Treaty Tribal fishery in Areas 6,7 and 7A with retention of sockeye. The catch evaluation by PSC staff of these fisheries indicated there was enough U.S. pink salmon TAC for these fisheries to be prosecuted. Canada strongly opposed the U.S. fisheries proposal citing conservation concerns for Early Summer run, Summer run and Late run, given that all sockeye management groups were in a LAER. In particular, Canada raised concerns about the retention of sockeye, the amount of sockeye expected to be harvested by the proposed U.S. fisheries, the gear used in the fishery and the fact that the proposed fishing area would

include the Apex, which is the most northwest section of the U.S. Panel Area waters. Canada did not provide information on what they would consider small but acceptable sockeye impacts. The U.S. decided to move forward with their fishery plans, given that it considered Canada's request to modify its proposal domestic fisheries management decisions outside the purview of Chapter 4. As the U.S. opposed Canada's objections, the U.S. provided a letter of rationale to the Panel preceding the start of their fishery on August 19, as per Chapter 4, paragraph 13diii. On August 18, prior to the opening of this U.S. pink directed fishery, catches totaled about 16,000 sockeye with about 11,000 caught by the test fisheries and 5,000 caught by Canada, predominantly consisting of unauthorized directed retention or unauthorized bycatch retention in fisheries directed at other species. In addition, close to 2,800 Fraser River pink salmon had been caught primarily by the test fishery as well as Canadian fisheries directed at other pink salmon stocks.

On August 18, the Fraser River water discharge at Hope was about 2,188 $m^3 \cdot s^{-1}$ which is approximately 29% less than average for this date. The temperature of the Fraser River at Qualark on August 18 was 20.8˚C, which is 2.2˚C greater than average for this date. For the Summer run, there were not enough days for an August 13 prediction for the pDBE using the 19-day model; however, based on the retrospective analysis for Summer run on low discharge years, the 31-day pre-season model was still the best performing model, therefore staff did not make a recommendation to change the pDBE for Summer run.

August 20 – 26, 2023:

The total accounted run to date was 1,204,600 sockeye salmon, consisting of 41,100 Early Stuart, 323,100 Early Summer run, 718,700 Summer run and 121,700 Late-run sockeye. The 5-day diversion rate was 86% which was well above the preseason forecast of 67%. For pink salmon the total accounted run to date at Mission was 621,700. The diversion rate for pink salmon was 19%, well below the pre-season forecast of 62%.

At Tuesday's panel meeting, they increased the Early Summer run, Summer run and Late-run run size to 335,000, 950,000 and 280,000, respectively. The associated 50% marine timing in Area 20 for the different management groups was July 26, August 13 and August 17, respectively. Even with this increase in run size all sockeye management groups remained in a low abundance exploitation rate (LAER) meaning there was no available harvest. The pink salmon run size remained unchanged at 17 million.

On August 25, catches totaled 24,000 Fraser River sockeye, with about 15,000 caught by various test fisheries, about 5,400 caught by Canada and about 3,700 caught by the U.S. These catches represented about 1.5% of the 1.6 million adopted run size. Including fishing-induced mortality brought the impact of fisheries to about 1.6% of the run size. Catches of Fraser River pink salmon totaled 88,000: 84,000 U.S. catch, less than 1,000 Canadian catch and 3,000 test fishing catch. The remaining Total Allowable Catch (TAC) balance exceeded 2.7 million for the U.S. and 8.1 million for Canada.

Both countries put forth pink directed fisheries proposals at Tuesday's meeting. From a staff perspective, the proposal put forth by the U.S. would not exceed the available TAC; however, there would be some sockeye mortality. The amount of sockeye mortality was discussed at length between the two parties to determine if it was small but acceptable. For the United States, the fisheries proposal originally included retention of sockeye but after the lengthy discussion between the two parties, they modified and re-submitted their fisheries proposal to sockeye non-retention. As a result, Canada adopted this proposal. Canada proposed a small ITQ troll fishery. No concerns were raised by staff or the U.S.

With the large amount of pink TAC available another fishery proposal was put forth by the U.S. at Friday's meeting. Although the proposal included non-retention of sockeye salmon, Canada was concerned with the U.S. fishing in Area 7A, specifically in the area defined by the apex (those waters north and west of the "Iwersen Point Line," defined as a line projected 233 degrees true from ruins of the Iwersen Dock (48°58'30.6"N, 123°5'6.5"W) on Point Roberts to the Active Pass Light (48°52'23"N, 123°17'26"W) on Georgina Point, Mayne Island, British Columbia, Canada), an area where delaying sockeye may hold. A catch evaluation done by staff did not take into account information about potential delaying stocks in Area 7A as there was limited information available to

assess if there were Late run sockeye delaying in this area in 2023. After a lengthy discussion, the U.S. planned to move ahead with the proposed fisheries, despite Canada's objection to the fishery proposal. As a result, the U.S. submitted a letter of rationale as per Chapter 4, paragraph 13d(iii).

On August 24, the Fraser River water discharge at Hope was 1,998 $m^3 \cdot s^{-1}$, which was still 28% lower than average for this date. DFO's Environmental Watch program projected that discharge would further decrease to 1,703 $m^3 \cdot s^{-1}$ over the next 10 days and river temperature was predicted to remain near the historical mean, around 17.9°C. Based on current Late run timing, September 17, the Late run (excluding Birkenhead/Big Silver) would have a less negative pDBE, -0.30, compared to the currently adopted pDBE, -0.74, which was based on the all years median excluding the dominant cycle and the best in-season approach based on the retrospective analysis conducted in 2022.

August 27 – September 2, 2023:

The total accounted run to date for sockeye was 1,424,700 consisting of 41,100 Early Stuart, 333,400 Early Summer-, 849,100 Summer- and 201,100 Late run sockeye, while for pink salmon, the accounted run to date was 1,968,400. In marine areas, purse seine test fishing catches for both sockeye and pink salmon had declined and the estimated diversion rates for both species through Johnstone Strait had increased to 99%. As a result of the declining catches and increased diversion rate, the Area 20 purse seine test fishery ended on Sept 1, 5 days earlier than scheduled. In the river, observations of Late run sockeye had increased and approximately 108,000 Late run were estimated to still be delaying their entry into the Fraser River. At Tuesday's meeting, the Panel increased the pink salmon run size to 20 million with an associated August 20 run timing. While this run size implied a higher productivity than in recent years, it was not unprecedented.

On September 1, catches totaled close to 30,000 Fraser River sockeye, with the main change caused by Canada who saw its catch increase from about 5,400 to 9,600, primarily due to unauthorised catch. Fraser River pink salmon catch by Friday had increased to 313,000 salmon: close to 300,000 U.S. catch, less than 3,000 Canadian catch and 10,000 test fishing catch. The remaining Total Allowable Catch (TAC) balance exceeded 3.2 million for the U.S. and 10.4 million for Canada.

At both the Tuesday and Friday meetings, both countries announced further pink directed fisheries with non-retention of sockeye. While the U.S. continued to open fisheries in all traditional areas, Canada opened Area H troll ITQ fisheries in the Gulf (Area 29) and later also included a limited entry Area B seine ITQ fishery in its proposal.

As of August 31, the Fraser River water discharge at Hope was 1,817 $m^3 \cdot s^{-1}$ which was similar to the historical minimum. The temperature of the Fraser River at Qualark has been declining given the time of the year but remained high and similar to historical maxima at 18.3°C.

September 3 – 9, 2023:

The total accounted sockeye run to date was 1,561,600 salmon, which was similar to the preseason forecast (1,564,000) and consisted of 41,100 Early Stuart, 326,600 Early Summer-, 901,700 Summer- and 292,200 Late-run sockeye. The accounted run to date for pink salmon was 5,089,900 pink salmon, which had not yet exceeded the preseason forecast of 6,135,000. With the closure of the Area 12 test fisheries on September 4, the annual diversion rates for sockeye and pink salmon were 67% and 36% respectively.

On September 8, catches totalled 37,000 Fraser River sockeye, while Fraser River pink salmon catch had increased to 503,000 salmon: 348,000 U.S. catch, 143,000 Canadian catch and 12,000 test fishing catch. Both countries proposed further pink directed fisheries to catch the substantial pink salmon TAC remaining.

September 10- 16, 2023:

The total accounted run to date was 1,597,400 sockeye salmon, consisting of 41,100 Early Stuart, 326,600 Early Summer-, 915,900 Summer- and 313,800 Late-run sockeye, as well as 8,357,000 pink salmon. The accounted run to date for pink salmon exceeded the preseason forecast

of 6,135,000. At Tuesday's meeting, the Panel adopted a decreased run size for pink salmon of 15,000,000 based on the lower than expected abundances observed at Mission.

On September 15, catches totaled 35,000 Fraser River sockeye (16,000 Canadian catch, 2,000 U.S. catch and 17,000 test fishing catch), and 847,000 Fraser River pink salmon (426,000 Canadian catch, 407,000 U.S. catch and 14,000 test fishing catch). On Tuesday, both countries proposed pink directed fisheries while on Friday, only Canada proposed further fisheries.

Table 1. Pre-season and in-season updates of run size, spawning escapement targets and other TAC-related values for Fraser River sockeye and pink salmon in 2023. The available harvest (run size minus spawning escapement target and management adjustment), catch to date, Mission escapement to date and migration timing are also shown.

				TAC*									
Date	Management Group	Total Abundance	Spawning Escapement Target	pMA	Manage-ment Adjust.	Test Fishing	Aboriginal Fishery Exemption	Total Deductions	Total Allowable Catch	Available Harvest **	Downstream Catch to date	Mission Escape. to date
June 21 Pre-season***	Early Stuart	23,000	23,000	1.08	24,800	142	0	23,000	0	0	0	0
	Early Summer	186,010	131,900	0.56	73,900	2,854	0	186,010	0	0	0	0
	Summer	1,166,900	1,046,600	0.23	240,700	11,864	0	1,166,900	0	0	0	0
	Late	188,320	188,320	1.00	188,300	2,029	0	188,320	0	0	0	0
	Sockeye	**1,564,230**	**1,389,820**		**527,700**	**16,889**	**0**	**1,564,230**	**0**	**0**	**0**	**0**
	Pink	**6,135,000**	**5,335,000**			**25,300**		**5,360,300**	**774,700**	**800,000**	**0**	**0**
July 14 In-season	Early Stuart	23,000	23,000	1.08	24,800	142	0	23,000	0	0	100	24,800
	Early Summer	186,010	131,900	0.56	73,900	2,854	0	186,010	0	0	200	20,300
	Summer	1,166,900	1,046,600	0.23	240,700	11,864	0	1,166,900	0	0	0	0
	Late	188,320	188,320	1.00	188,300	2,029	0	188,320	0	0	0	0
	Sockeye	**1,564,230**	**1,389,820**		**527,700**	**16,889**	**0**	**1,564,230**	**0**	**0**	**300**	**45,100**
	Pink	**6,135,000**	**5,335,000**			**25,300**		**5,360,300**	**774,700**	**800,000**	**0**	**0**
July 18 In-season	Early Stuart	23,000	23,000	1.08	24,800	142	0	23,000	0	0	100	28,500
	Early Summer	186,010	131,900	0.56	73,900	2,854	0	186,010	0	0	600	32,400
	Summer	1,166,900	1,046,600	0.23	240,700	11,864	0	1,166,900	0	0	0	300
	Late	188,320	188,320	1.00	188,300	2,029	0	188,320	0	0	0	100
	Sockeye	**1,564,230**	**1,389,820**		**527,700**	**16,889**	**0**	**1,564,230**	**0**	**0**	**700**	**61,300**
	Pink	**6,135,000**	**5,335,000**			**25,300**		**5,360,300**	**774,700**	**800,000**	**0**	**0**
July 21 In-season	Early Stuart	23,000	23,000	1.08	24,800	142	0	23,000	0	0	100	36,500
	Early Summer	186,010	131,900	0.56	73,900	2,854	0	186,010	0	0	1,100	61,400
	Summer	1,166,900	1,046,600	0.23	240,700	11,864	0	1,166,900	0	0	0	500
	Late	188,320	188,320	1.00	188,300	2,029	0	188,320	0	0	0	100
	Sockeye	**1,564,230**	**1,389,820**		**527,700**	**16,889**	**0**	**1,564,230**	**0**	**0**	**1,200**	**98,500**
	Pink	**6,135,000**	**5,335,000**			**25,300**		**5,360,300**	**774,700**	**800,000**	**0**	**0**
July 25 In-season	Early Stuart	23,000	23,000	1.08	24,800	142	0	23,000	0	0	200	37,500
	Early Summer	186,010	131,900	0.56	73,900	2,854	0	186,010	0	0	1,500	85,600
	Summer	1,166,900	1,046,600	0.23	240,700	11,864	0	1,166,900	0	0	300	1,900
	Late	188,320	188,320	1.00	188,300	2,029	0	188,320	0	0	0	100
	Sockeye	**1,564,230**	**1,389,820**		**527,700**	**16,889**	**0**	**1,564,230**	**0**	**0**	**2,000**	**125,100**
	Pink	**6,135,000**	**5,335,000**			**25,300**		**5,360,300**	**774,700**	**800,000**	**100**	**0**
July 28 In-season	Early Stuart	43,000	43,000	1.70	73,100	142	0	43,000	0	0	200	39,900
	Early Summer	186,010	131,900	0.56	73,900	2,854	0	186,010	0	0	1,900	129,900
	Summer	1,166,900	1,046,600	0.23	240,700	11,864	0	1,166,900	0	0	700	12,100
	Late	188,320	188,320	1.00	188,300	2,029	0	188,320	0	0	0	300
	Sockeye	**1,564,230**	**1,389,820**		**576,000**	**16,889**	**0**	**1,584,230**	**0**	**0**	**2,800**	**182,200**
	Pink	**6,135,000**	**5,335,000**			**25,300**		**5,360,300**	**774,700**	**800,000**	**100**	**0**
August 1 In-season	Early Stuart	43,000	43,000	1.70	73,100	142	0	43,000	0	0	200	40,600
	Early Summer	186,010	131,900	0.56	73,900	2,854	0	186,010	0	0	2,300	154,800
	Summer	1,166,900	1,046,600	0.23	240,700	11,864	0	1,166,900	0	0	1,300	25,700
	Late	188,320	188,320	1.00	188,300	2,029	0	188,320	0	0	100	300
	Sockeye	**1,564,230**	**1,389,820**		**576,000**	**16,889**	**0**	**1,584,230**	**0**	**0**	**3,900**	**221,400**
	Pink	**6,135,000**	**5,335,000**			**25,300**		**5,360,300**	**774,700**	**800,000**	**300**	**0**
August 4 In-season	Early Stuart	43,000	43,000	1.70	73,100	142	0	43,000	0	0	200	40,900
	Early Summer	240,000	131,900	1.08	142,500	2,854	0	240,000	0	0	2,700	181,700
	Summer	1,166,900	1,046,600	0.23	240,700	11,864	0	1,166,900	0	0	1,800	34,000
	Late	188,320	188,320	1.00	188,300	2,029	0	188,320	0	0	100	700
	Sockeye	**1,564,230**	**1,389,820**		**644,600**	**16,889**	**0**	**1,638,220**	**0**	**0**	**4,800**	**257,300**
	Pink	**6,135,000**	**5,335,000**			**25,300**		**5,360,300**	**774,700**	**800,000**	**300**	**0**
August 8 In-season	Early Stuart	43,000	43,000	1.70	73,100	142	0	43,000	0	0	200	40,800
	Early Summer	240,000	131,900	1.08	142,500	2,854	0	240,000	0	0	3,000	217,200
	Summer	1,166,900	1,046,600	0.23	240,700	11,864	0	1,166,900	0	0	2,800	81,500
	Late	188,320	188,320	1.00	188,300	2,029	0	188,320	0	0	300	2,000
	Sockeye	**1,564,230**	**1,389,820**		**644,600**	**16,889**	**0**	**1,638,220**	**0**	**0**	**6,300**	**341,500**
	Pink	**6,135,000**	**5,335,000**			**25,300**		**5,360,300**	**774,700**	**800,000**	**400**	**0**
August 11 In-season	Early Stuart	41,000	41,000	1.70	69,700	142	0	41,000	0	0	200	40,900
	Early Summer	290,000	145,000	1.08	156,600	2,854	0	290,000	0	0	3,100	239,300
	Summer	1,166,900	1,046,600	0.23	240,700	11,864	0	1,166,900	0	0	3,500	138,400
	Late	188,320	188,320	1.00	188,300	2,029	0	188,320	0	0	500	8,200
	Sockeye	**1,564,230**	**1,389,820**		**655,300**	**16,889**	**0**	**1,686,220**	**0**	**0**	**7,300**	**426,800**
	Pink	**6,135,000**	**5,335,000**			**25,300**		**5,360,300**	**774,700**	**800,000**	**400**	**9,100**
August 15 In-season	Early Stuart	41,000	41,000	1.70	69,700	142	0	41,000	0	0	200	40,900
	Early Summer	290,000	145,000	1.08	156,600	2,854	0	290,000	0	0	3,400	269,000
	Summer	1,166,900	1,046,600	0.23	240,700	11,864	0	1,166,900	0	0	4,800	242,500
	Late	188,320	188,320	1.00	188,300	2,029	0	188,320	0	0	700	14,600
	Sockeye	**1,564,230**	**1,389,820**		**655,300**	**16,889**	**0**	**1,686,220**	**0**	**0**	**9,100**	**567,000**
	Pink	**8,575,000**	**6,000,000**			**25,300**		**6,025,300**	**2,549,700**	**2,575,000**	**500**	**16,200**

Date		Management Group	Total Abundance	TAC* Spawning Escapement Target	pMA	Manage-ment Adjust.	Test Fishing	Aboriginal Fishery Exemption***	Total Deductions	Total Allowable Catch	Available Harvest **	Downstream Catch to date	Mission Passage to date
August 18	In-season	Early Stuart	41,000	41,000	1.70	69,700	142	0	41,000	0	0	200	40,900
		Early Summer	310,000	155,000	1.08	167,400	2,854	0	310,000	0	0	3,800	292,200
		Summer	800,000	800,000	0.23	184,000	11,864	0	800,000	0	0	6,300	335,200
		Late	188,320	188,320	1.00	188,300	2,029	0	188,320	0	0	1,000	21,000
		Sockeye	**1,339,320**	**1,389,820**		**609,400**	**16,889**	**0**	**1,339,320**	**0**	**0**	**11,300**	**689,300**
		Pink	**17,000,000**	**6,000,000**			**25,300**		**6,025,300**	**10,974,700**	**11,000,000**	**2,800**	**31,500**
August 22	In-season	Early Stuart	41,000	41,000	1.70	69,700	142	0	41,000	0	0	200	40,900
		Early Summer	335,000	167,500	1.08	180,900	2,854	0	335,000	0	0	4,000	314,400
		Summer	950,000	950,000	0.23	218,500	11,864	0	950,000	0	0	9,800	584,000
		Late	280,000	280,000	1.00	280,000	2,029	0	280,000	0	0	2,700	72,200
		Sockeye	**1,606,000**	**1,389,820**		**749,100**	**16,889**	**0**	**1,606,000**	**0**	**0**	**16,700**	**1,011,500**
		Pink	**17,000,000**	**6,000,000**			**25,300**		**6,025,300**	**10,974,700**	**11,000,000**	**47,700**	**113,700**
August 25	In-season	Early Stuart	41,000	41,000	1.70	69,700	142	0	41,000	0	0	200	40,900
		Early Summer	335,000	167,500	1.08	180,900	2,854	0	335,000	0	0	3,900	319,200
		Summer	950,000	950,000	0.23	218,500	11,864	0	950,000	0	0	10,900	707,800
		Late	280,000	280,000	1.00	280,000	2,029	0	280,000	0	0	3,300	118,400
		Sockeye	**1,606,000**	**1,389,820**		**749,100**	**16,889**	**0**	**1,606,000**	**0**	**0**	**18,300**	**1,186,300**
		Pink	**17,000,000**	**6,000,000**			**25,300**		**6,025,300**	**10,974,700**	**11,000,000**	**88,400**	**533,300**
August 29	In-season	Early Stuart	41,000	41,000	1.70	69,700	142	0	41,000	0	0	200	40,900
		Early Summer	335,000	167,500	1.08	180,900	2,854	0	335,000	0	0	3,900	326,900
		Summer	950,000	950,000	0.23	218,500	11,864	0	950,000	0	0	10,800	811,200
		Late	280,000	280,000	1.00	280,000	2,029	0	280,000	0	0	4,100	171,700
		Sockeye	**1,606,000**	**1,389,820**		**749,100**	**16,889**	**0**	**1,606,000**	**0**	**0**	**19,000**	**1,350,700**
		Pink	**20,000,000**	**6,000,000**			**25,300**		**6,025,300**	**13,974,700**	**14,000,000**	**209,300**	**873,500**
September 1	In-season	Early Stuart	41,000	41,000	1.70	69,700	142	0	41,000	0	0	200	40,900
		Early Summer	335,000	167,500	1.08	180,900	2,854	0	335,000	0	0	4,000	329,400
		Summer	950,000	950,000	0.23	218,500	11,864	0	950,000	0	0	11,100	838,000
		Late	280,000	280,000	1.00	280,000	2,029	0	280,000	0	0	4,300	196,800
		Sockeye	**1,606,000**	**1,389,820**		**749,100**	**16,889**	**0**	**1,606,000**	**0**	**0**	**19,600**	**1,405,100**
		Pink	**20,000,000**	**6,000,000**			**25,300**		**6,025,300**	**13,974,700**	**14,000,000**	**311,400**	**1,657,000**
September 5	In-season	Early Stuart	41,000	41,000	1.70	69,700	142	0	41,000	0	0	200	40,900
		Early Summer	335,000	167,500	1.08	180,900	2,854	0	335,000	0	0	3,900	322,100
		Summer	950,000	950,000	0.23	218,500	11,864	0	950,000	0	0	11,400	875,600
		Late	280,000	280,000	1.00	280,000	2,029	0	280,000	0	0	4,500	233,300
		Sockeye	**1,606,000**	**1,389,820**		**749,100**	**16,889**	**0**	**1,606,000**	**0**	**0**	**20,000**	**1,471,900**
		Pink	**20,000,000**	**6,000,000**			**25,300**		**6,025,300**	**13,974,700**	**14,000,000**	**373,700**	**3,752,800**
September 8	In-season	Early Stuart	41,000	41,000	1.70	69,700	142	0	41,000	0	0	200	40,900
		Early Summer	335,000	167,500	1.08	180,900	2,854	0	335,000	0	0	3,900	322,700
		Summer	950,000	950,000	0.23	218,500	11,864	0	950,000	0	0	11,400	890,300
		Late	280,000	280,000	1.00	280,000	2,029	0	280,000	0	0	4,600	287,600
		Sockeye	**1,606,000**	**1,389,820**		**749,100**	**16,889**	**0**	**1,606,000**	**0**	**0**	**20,100**	**1,541,500**
		Pink	**20,000,000**	**6,000,000**			**25,300**		**6,025,300**	**13,974,700**	**14,000,000**	**501,800**	**4,588,100**
September 12	In-season	Early Stuart	41,000	41,000	1.70	69,700	142	0	41,000	0	0	200	40,900
		Early Summer	335,000	167,500	1.08	180,900	2,854	0	335,000	0	0	3,900	322,700
		Summer	950,000	950,000	0.23	218,500	11,864	0	950,000	0	0	10,700	895,000
		Late	280,000	280,000	1.00	280,000	2,029	0	280,000	0	0	3,900	306,300
		Sockeye	**1,606,000**	**1,389,820**		**749,100**	**16,889**	**0**	**1,606,000**	**0**	**0**	**18,700**	**1,564,900**
		Pink	**15,000,000**	**6,000,000**			**25,300**		**6,025,300**	**8,974,700**	**9,000,000**	**717,900**	**6,084,700**
September 27	End-of-season	Early Stuart	41,000	41,000	1.70	69,700	142	0	41,000	0	0	200	40,900
		Early Summer	326,000	163,000	1.08	176,000	2,854	0	326,000	0	0	3,900	322,500
		Summer	926,000	926,000	0.23	213,000	11,864	0	926,000	0	0	10,800	914,900
		Late	359,000	300,000	1.00	300,000	2,029	0	359,000	0	0	4,000	355,400
		Sockeye	**1,652,000**	**1,389,820**		**758,700**	**16,889**	**0**	**1,652,000**	**0**	**0**	**18,900**	**1,633,700**
		Pink	**10,300,000**	**6,000,000**			**25,300**		**6,025,300**	**4,274,700**	**4,300,000**	**926,600**	**9,260,500**

* The TAC is determined by the run sizes and TAC deductions (spawning escapement targets, management adjustments, projected test fishing catches and AFE Exemptions) that were in effect when Panel had the last in-season meeting (Sept. 27).

** Available Harvest = Total abundance minus spawning escapement target and Management Adjustment. Management groups that meet the criteria of Low Abundance Exploitation Rate (LAER) are assumed to have no Available Harvest (ie. 0) because a LAER is not intended to provide direct harvest

*** Pre-season values reflect those adopted by the Panel in effect on the date shown. In some cases there may be slight differences between these values and those used in the base case planning model that was completed earlier during pre-season planning.

At the end of season meeting on September 27 the Panel adopted updated run sizes for the Early Summer, Summer and Late run sockeye of 326,000, 926,000 and 359,000, respectively and for pink salmon, 10,300,000. There were no changes to the timing.

Overviews of pink salmon directed commercial fisheries openings in U.S. and Canadian Panel Areas are contained in Table 2 and 3. There were no commercial fisheries directed at Fraser sockeye salmon.

Table 2. Number of days when major Canadian commercial fisheries in the Fraser river Panel Area were open for directed harvest of Fraser River pink salmon in 2023. Regulatory control of Canadian Panel Areas was relinquished by the Panel on September 23 for Area 20, September 30 for Areas 17 and 18, and October 14 for Area 29, in accordance with pre-season regulations (Appendix D).

	Panel Areas					Non-Panel Areas			
	20		29		18, 29	11-16			
Date	Purse Seine	Gillnet	Purse Seine	Gillnet	Troll	Purse Seine	Gillnet	Troll H	Troll G
Jun.14-Aug.1									
Aug.2-Aug.8									
Aug.9-Aug.15									
Aug.16-Aug.22									
Aug.23-Aug.29					6				
Aug.30-Sep.5			3		7				
Sep.6-Sep.12			7		7				
Sep.13-Sep.19			6		6				
Sep.20-Sep.26									
Sep.27-Oct.3									
Oct.4-Oct.10									
Total	0	0	16	0	26	0	0	0	0

Table 3. Number of days when major U.S. net fisheries in the Fraser River Panel Area were open for directed harvest of Fraser River pink salmon in 2023. Regulatory control of U.S. Panel Areas was relinquished by the Panel as follows; Areas 4B, 5, 6, 6C on September 9 and Areas 6, 6A, 7 and 7A (excluding the Apex) on September 13 by in-season order (Appendix E) and Area 7A lying westerly of a straight line drawn from the low water range marker in Boundary Bay on the International Boundary through the east tip of Point Roberts in the State of Washington to the East Point Light on Saturna Island in the Province of British Columbia October 7, 2023, as per pre-season regulations (Appendix D).

	Treaty Tribes		All Citizen		
	Areas	Areas	Areas 7 and 7A		
Date	4B, 5, 6C	6, 7, 7A	Purse Seine	Gillnet	Reefnet
Jun.14-Aug.1					
Aug.2-Aug.8					
Aug.9-Aug.15					
Aug.16-Aug.22	4	1			
Aug.23-Aug.29	7	6	6	6	7
Aug.30-Sep.5	7	7	7	7	7
Sep.6-Sep.12	4	7	7	7	7
Sep.13-Sep.19		1			
Sep.20-Sep.26					
Sep.27-Oct.3					
Total	22	22	20	20	21

IV. MANAGEMENT INFORMATION

To facilitate decision making, the Panel requires information about the abundance, timing, migration route and expected catch levels of Fraser River sockeye (by management group) and pink salmon. Pre-season, these quantities are provided by DFO in the form of forecasts that are augmented by PSC Staff through analysis of historical data. Staff update these estimates in-season through various assessment programs (Appendix F). Stock monitoring programs collect information about abundance at various points along the migration route using test fisheries and hydroacoustics. The locations and schedule for these PSC and DFO programs are listed in Table 4. These data are augmented with catch information from commercial, First Nations, recreational and other fisheries that are provided by the two countries. Stock identification programs collect and analyze biological samples (e.g., DNA, scales) from various fisheries, which are used to apportion the total abundance of sockeye into component stock groups. Table 5 shows the sockeye stock resolution that was reported in 2023.

Table 4. Panel-approved stock monitoring operations (test fishery, hydroacoustic and observer) conducted during the 2023 fishing season.

Area	Location	Gear	Dates	Operated by
Canadian Panel Areas				
20	Juan de Fuca Str.	Gillnet	July 10 - July 29	PSC
20	Juan de Fuca Str.	Purse Seine	July 21 - August 31	PSC
29-13	Fraser R. (Cottonwood)	Gillnet	July 26 - September 14	PSC
29-16	Fraser R. (Whonnock)	Gillnet	June 26 - October 2	PSC
29-16	Fraser R. (Mission)	Hydroacoustic	July 1 - October 2	PSC
29-17	Fraser R. (Brownsville Bar)	Gillnet	July 12 - August 27	PSC
Canadian non-Panel Areas				
12	Queen Charlotte Str. (Round Is.)	Gillnet	July 11 - July 28	DFO
12	Johnstone Str. (Blinkhorn)	Purse Seine	July 20 - September 4	DFO
	Fraser R. (Hells Gate)	Observer	July 5 - September 25	PSC
	Fraser R. (Qualark)	Gillnet	July 2 - October 4	DFO
	Fraser R. (Qualark)	Hydroacoustic	July 1 - October 5	DFO
United States Panel Areas				
7	San Juan Islands	Reefnet	August 14 - August 16	PSC

Stock assessment activities conducted by Staff use the data described above to provide estimates of daily catch, daily abundance, Mission escapement, migration timing and diversion rate, which are the basis for estimating total abundances, escapement targets and catch allocations for the different sockeye management groups. Staff also provide estimates of Management Adjustments (MAs), which are a measure of how many additional fish should be allowed to escape past Mission to increase the likelihood of achieving sockeye spawning escapement targets, given historical discrepancies, current year migration timing and observed and forecasted river conditions from DFO's Environmental Watch program. These data are compiled and analysed by Staff and the results provided to the Panel. The section "In-season Management" above summarized how these estimates changed each week as data from the programs accumulated. The following sections provide a summary of the end-of-season results.

Table 5. Individual stocks included in the Fraser River sockeye stock groups used in 2023.

Stock Group	Component Stocks
Early Stuart	
Early Stuart	Early Stuart stocks
Early Summer	
Chilliwack	Chilliwack Lake, upper Chilliwack River
Nadina/ Bowron/Gates/ Nahatlatch/ Taseko	Nadina, Bowron, Gates, Nahatlatch, Taseko
Pitt/ Alouette/ Coquitlam	Pitt, Alouette, Coquitlam
Early Thompson	Scotch, Seymour, early Eagle, Cayenne, Upper Adams, upper Barrière River
Summer	
Raft/N.Thompson	Raft, North Thompson main stem
Chilko/Quesnel	Chilko River, south end Chilko Lake, north end Chilko Lake, Horsefly, McKinley, Mitchell, Roaring, Wasko, Blue Lead
Late Stuart/Stellako	Stellako, Tachie, Middle, Pinchi, Kuzkwa
Harrison/ Widgeon	Harrison, Widgeon
Late	
Birkenhead/Big Silver	Birkenhead, Big Silver
Late Shuswap/Portage	Lower Adams, Portage, Lower Shuswap, Middle Shuswap, late Eagle, Little River
Weaver/Cultus	Weaver, Cultus

A. Abundance

The final in-season run size estimates adopted by the Panel were 1,652,000 Fraser River sockeye and 10,300,000 pink salmon (Table 1). Despite this higher than forecast abundance of sockeye salmon there were no sockeye directed fishing opportunities in the US and only very limited terminal FSC fisheries in Canada. The post-season abundance estimate for sockeye salmon (1,692,800 fish, Tables 9 and 10) based on spawning ground enumerations, accounted catches and differences between estimates is slightly more (3%) than the end-of-season estimate, and 8% greater than the pre-season median forecast (1,564,230).

Research at Mission[13,14] has produced hydroacoustic methods that provide reliable daily estimates of pink salmon passage. The post season run-size estimate of 10,513,300 fish (Table 9) was calculated by adding the estimated catch below Mission (934,300 fish) to the Mission passage estimate (9,579,000 fish, Table 8). This estimate is 71% greater than the median pre-season forecast (6,135,000).

B. Migration Timing and Diversion Rate

Figures 3 and 4 show the forecasted and observed daily abundances, and Area 20 50% migration dates for each sockeye management group and for the total Fraser River sockeye and pink salmon. The end-of-season estimates of marine migration timing in 2023 were earlier than preseason expectations for Early Stuart (5-days earlier), Early Summer-run (9-days earlier), Summer-run (4-

[13] Xie, Y., F. J. Martens, and J. L. Nelitz. 2012. Implementation of stationary sub-sampling systems to estimate salmon passage in the Lower Fraser River: Year 1 of 2011 and 2012 project report to Southern boundary restoration and enhancement fund. Pacific Salmon Commission, Vancouver, British Columbia. May, 2012.

[14] Martens, F.J. and Y. Xie. 2014. Estimation of near-shore salmon passage using stratified vertical sampling by DIDSON sonar: A final project report to the southern boundary restoration and enhancement fund. Pacific Salmon Commission. June, 2014.

days earlier), and Late-run (6-days earlier) management groups, as well as for pink salmon (8-days earlier). These timings were 2-days earlier than the cycle line median timing for Early Stuart and Early Summer management groups but were later than the cycle line median for the Summer (5-days later) and Late-run (1-days later) management groups. The overall sockeye run was five days earlier than expected pre-season. The timing for pink salmon was eight days earlier than the recent-years historical median (1999-2021), and 12 days earlier than the long-term historical median (1987-2021). Pink salmon timing was one day earlier than late run timing which caused sockeye and pink salmon migrations to overlap more than expected pre-season.

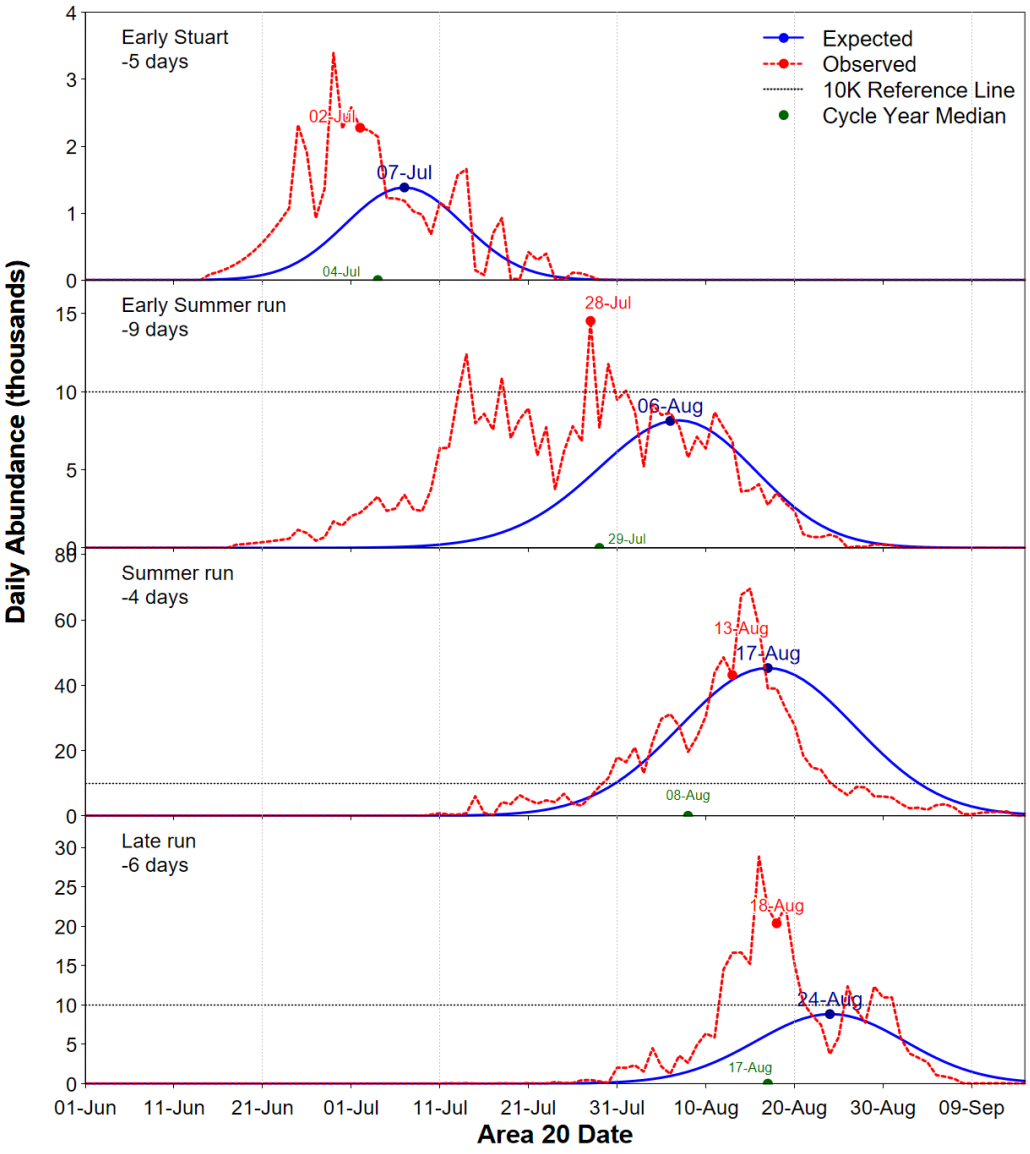

Figure 3. Pre-season expectations and post-season reconstructions of daily Fraser River sockeye salmon abundance by management group in 2023 (Area 20 date), including the observed 50% dates and number of days difference with pre-season expectations.

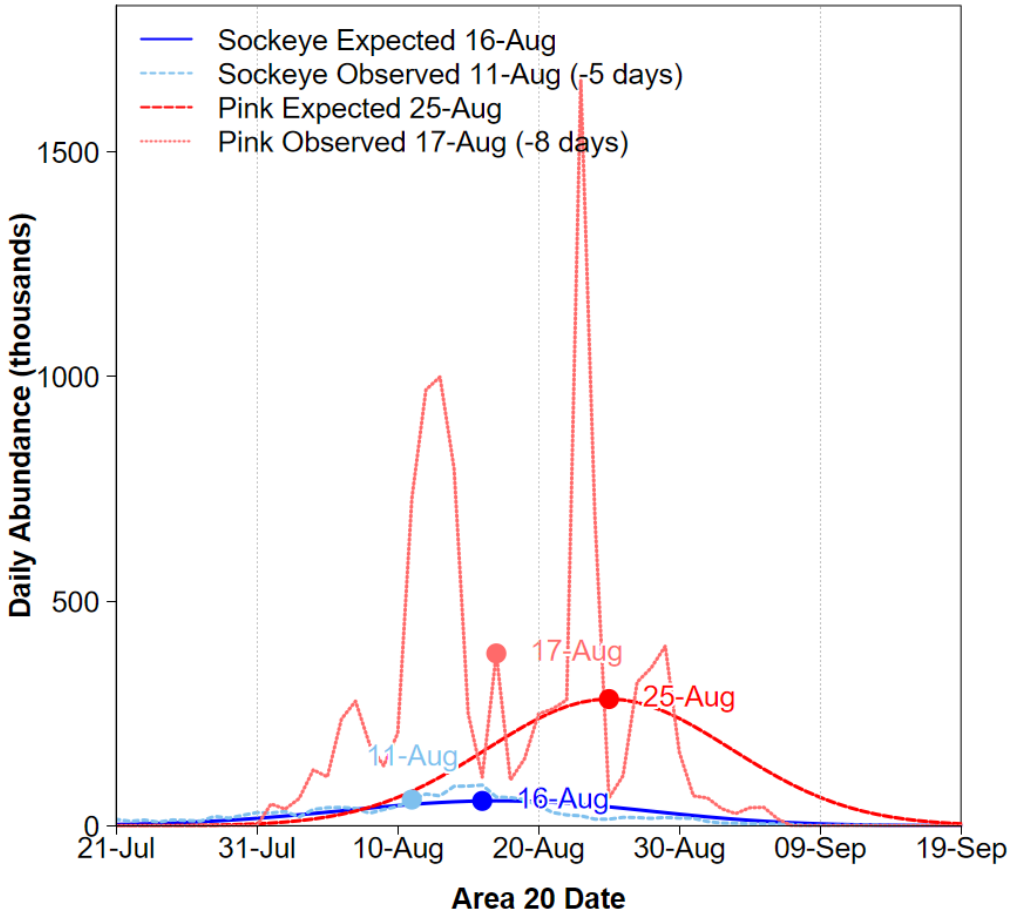

Figure 4. Pre-season projections and post-season reconstructions of daily Fraser River sockeye and pink salmon abundance in 2023 (Area 20 date), including the observed 50% dates and number of days difference with pre-season expectations.

The diversion rate in 2023 was the same as forecast for Fraser sockeye (67%) but lower than forecast for pink salmon. For Fraser River pink salmon, the observed annual diversion through Johnstone Strait was 34%, compared to the initial forecast of 53% used for pre-season planning and the updated forecast from DFO in August of 62% (Figure 5).

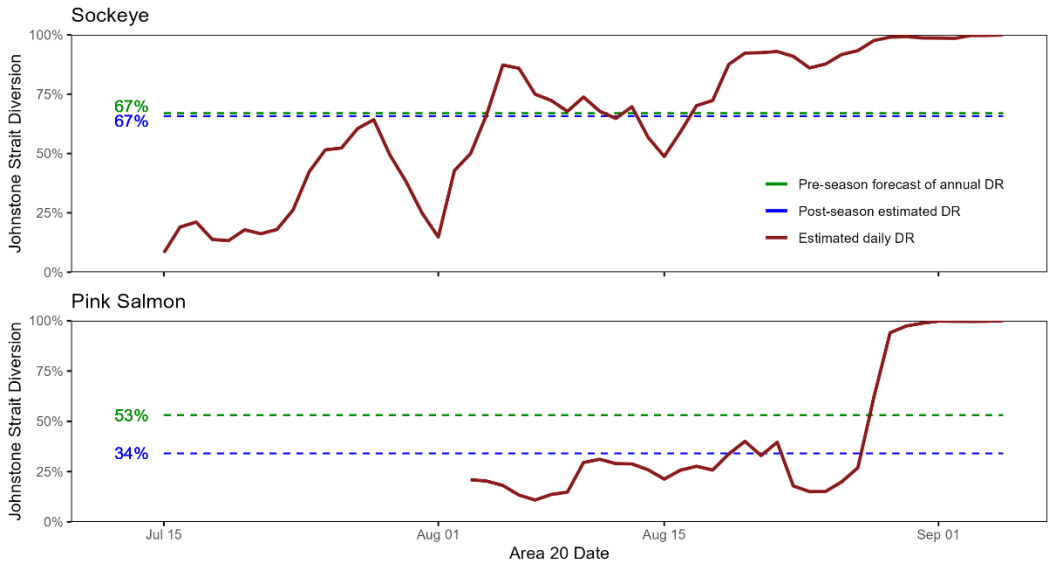

Figure 5. Pre-season forecast of annual Johnstone Strait diversion rate (DR) for Fraser sockeye salmon, compared to post-season estimates of daily and annual rates for 2023.

C. Big Bar Landslide

On, June 23, 2019, the Big Bar rockslide was discovered along the Fraser River north of Lillooet, close to the Big Bar Ferry (Figure 6). Over 85,000 cubic metres of rock had sheared off a 125-metre-high cliff and had fallen into an already narrow portion of the Fraser River (Figure 7). The rockslide created a five-metre waterfall that formed an upstream migration barrier for salmon with spawning grounds above Big Bar. A Unified Command Incident Management Team was set up in response to the slide which involved collaboration between First Nations, Federal and Provincial governments. The response both immediate and on-going was to improve natural and assisted passage through or over the slide and monitor successful passage and fish condition of the Fraser River salmon spawning above Big Bar. (https://www.pac.dfo-mpo.gc.ca/pacific-smon-pacifique/big-bar-landslide-eboulement/index-eng.html).

In 2023, 63% of the total Fraser River sockeye run, 100% of the Early Stuart, 49% of the Early Summer run, and 92% of the Summer run migrated past the slide site. To provide in-season feedback to managers about natural passage success of salmon during the potential high discharge period, monitoring operations ran through the month of July. Hydroacoustic fish monitoring stations were set up downstream (Alfalfa) and upstream (Churn Creek) of the slide. The SONAR program operated from July 4 to July 31 and radio tag application occurred at the Matsqui fishwheel site from June 26 to July 28. The Environmental Watch group monitored a fine scale array at the landslide and throughout the lower canyon. The receivers near the landslide were similar to 2022, however the rest of the array was reduced to encompass two sites near Lillooet, a site at Soda Creek and three terminal stations at Stuart, Nadina and Stellako.

Discharge levels at Big Bar were at or below the historical minima (1991-2020) throughout the sockeye migration. There were no upstream migration problems observed at the Big Bar slide site.

Early Stuart brood stock were collected at the Matsqui fish wheel as well as in the natal area. Brood stock were also collected from the Upper Bowron River and Taseko Lake to address ongoing conservation concerns, which had been exacerbated by the rock slide.

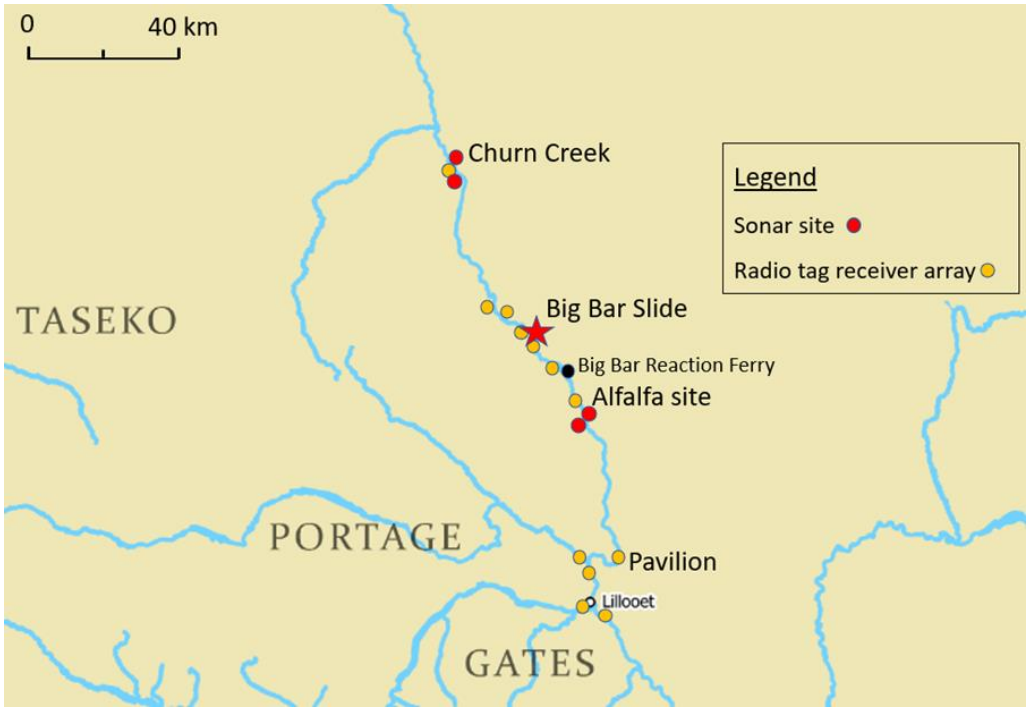

Figure 6. Map of sonar, salmon capture and radio tag receiver locations on the Fraser River near the Big Bar landslide in 2023.

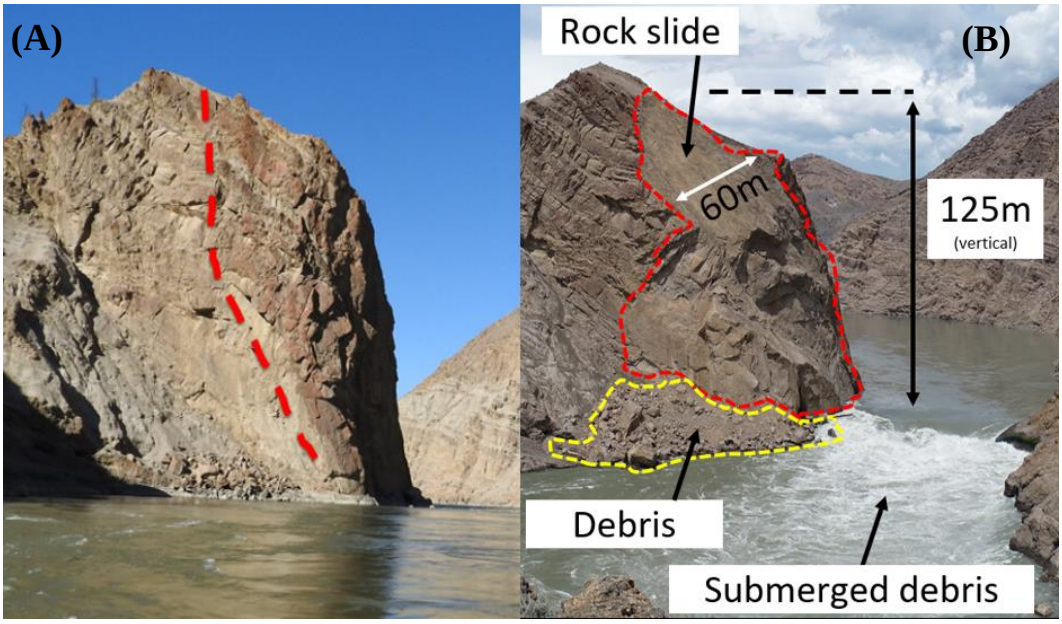

Figure 7. Big Bar Site before (A) and after (B) the slide. (A) The red line depicts what part of the cliff fell into the Fraser River. (B) Rock and debris 125 m in height and 60 m in width fell onto the banks and into the Fraser River.

D. Management Adjustments and DBEs

Management Adjustments (MAs) are based on statistical models [15] that consider the historical differences between in-season projections of spawning escapement (i.e., Mission escapement minus catch above Mission, or "potential spawning escapement") and post-season estimates (i.e., spawning ground estimates).[16]

Pre-season MA predictions and Difference Between Estimates (DBEs) are based on median values from historical datasets for each management group or are based on models using long-range forecasts of river conditions (temperature and discharge) and in-river migration timing.[17] In-season values are generated using updated migration timing estimates and observed and/or short-range forecasts of lower river discharge and temperature in combination with other considerations such as watershed-wide environmental conditions, and evidence of migratory distress.[17,18] In contrast, post-season values are calculated independently of any environmental data using post-season estimates of potential spawning and spawning ground escapements.

In 2023, low discharge levels predominated conditions in the Fraser River. On May 1, the River Forecast Centre reported that the overall basin snow water index for the entire Fraser basin was at 88% of normal. Peak freshet was in early/mid May. By June 15 the basin snow water index was substantially below normal, averaging 4% of normal across the province. The discharge levels at Hope were below or near the historical minima (1991-2020) for the entire sockeye migration (Figure 8). Drought conditions across the province prevailed. Due to the low discharge levels, the Fraser River was more susceptible to the above average air temperatures. At Qualark, Fraser River Temperatures were more than one standard deviation above average and near the historical maxima (1991-2020) for most of the season (Figure 8).

A summary of the pre-season and in-season MA models used during 2023 are provided in Appendix F "Management Adjustment and DBE", Table F4. Pre-season the adopted pMAs were based on the best performing forecast method identified in the pre-season retrospective analysis of the different pDBE approaches (Table 6). Due to the low total pre-season forecasts for Early Stuart and Late-run sockeye, their pre-season MAs did not have management implications. In-season, the Panel was presented with pDBE estimates for each management group from the best performing in-season pDBE approach (Table 6) identified in a retrospective analysis presented to the Panel in 2022. Due to the prevailing drought conditions and concern regarding its impact on sockeye migration, the Panel was also presented with a retrospective analysis of the different pDBE approaches in low discharge years for Early Summer run and Summer run (Table F4). In-season, the Panel adopted a pMA of 1.70 from the Threshold Approach for Early Stuart, given that the average temperature exceeded 17.5°C. For Early Summer run, the Panel adopted a pMA of 1.08 from the 19-day Temperature and Discharge Model, which was identified as the best performing pDBE approach in low discharge years. The retrospective analysis of pDBE approaches in low discharge years for Summer run indicated that staying with the pre-season model was the best approach. No changes were made to the Summer-run and Late-run pMAs (Table 7).

[15] Forrest, M.R. and Hague, M.J. 2022. DBE Temperature and Discharge Model. In: Michielsens, C.G.J. and Martens, F.J. Editors. Overview of pre-season and in-season assessment methods for Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 49, 192-196 p

[16] Forrest, M.R. and Hague, M.J. 2022. Management Adjustments. In: Michielsens, C.G.J. and Martens, F.J. Editors. Overview of pre-season and in-season assessment methods for Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 49, 179-184 p

[17] Forrest, M.R. and Hague, M.J. 2022. Fraser River Sockeye Management Adjustments. In: Michielsens, C.G.J. and Martens, F.J. Editors. Overview of pre-season and in-season assessment methods for Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 49, 24-28 p

Table 6. Best performing pDBE approach identified by the retrospective analysis of the pre-season and in-season pDBE approach for each management group.

	Pre-season recommended method	In-season recommended method
Early Stuart	Median (1995-2022)	Threshold Approach (1977-2022)
Early Summer run	All-years median	All-years median
Summer run	Pre-season 31-day model	Pre-season 31-day model
Late run	Dominant/other years median	Dominant/other years median

Table 7. Pre-season, in-season and post-season estimates of DBEs (differences between estimates) and pMAs (proportional management adjustments). Pre-season and in-season adopted values reflect the final values adopted by the Panel either prior to the season or for in-season management. Observed DBEs are calculated from final in-season estimates of potential spawning escapement and post-season estimates of spawning populations based on field enumeration programs conducted by DFO. (See Appendix A: Glossary of terms and abbreviations for DBE definition; and footnotes and Appendix F for more details on the methodologies and data sets used for each aggregate).

Description	Early Stuart		Early Summer run Aggregate		Summer run Aggregate		Late run Aggregate	
	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA
Pre-season adopted	-52%	1.08	-36%	0.56	-19%	0.23	-50%	1.00
In-season adopted	-63%	1.70	-52%	1.08	-19%	0.23	-50%	1.00
Observed[1]	-76%	3.11	-44%	0.79	-34%	0.52	-63%	1.70

1 Derived from Near Final escapement estimates.

Spawning estimates for all management groups except the Early Summer run failed to reach in-season predictions of spawning abundance. In-season, the Panel adopted a more negative pDBE (-63%) for Early Stuart based on the Threshold Approach, however, fewer fish were estimated on the spawning ground than predicted in-season and the observed pDBE for Early Stuart (-76%) was more negative than adopted. For Early Summer run, the observed pDBE (-44%) was more negative than predicted pre-season (-36%), however, less negative than adopted in-season (-52%). Although the observed pDBE for the Early Summer run aggregate was less negative than adopted in-season, with the exception of the Nadina/Bowron and the Pitt groups, the other Early Summer run stocks saw fewer sockeye on the spawning grounds than predicted in-season. For Summer run and Late run, the Panel stayed with the pre-season adopted pDBE of -19% and -50% respectively, however fewer sockeye were estimated on the spawning ground and the observed pDBE for both groups was more negative (-34% and -63%, respectively). Spawning ground estimates exceeded the spawning escapement target (SET) for the Early Summer run; however, the SET was not achieved for Early Stuart, Summer run and Late run. The spawning ground adult escapement estimates were 10,100 for the Early Stuart, 185,900 for the Early Summer run, 592,900 for the Summer run and 129,300 for the Late run (Table 14). These compared to a SET of 41,000 sockeye, 163,000 sockeye, 926,000 sockeye and 300,000 sockeye, respectively (Table 13).

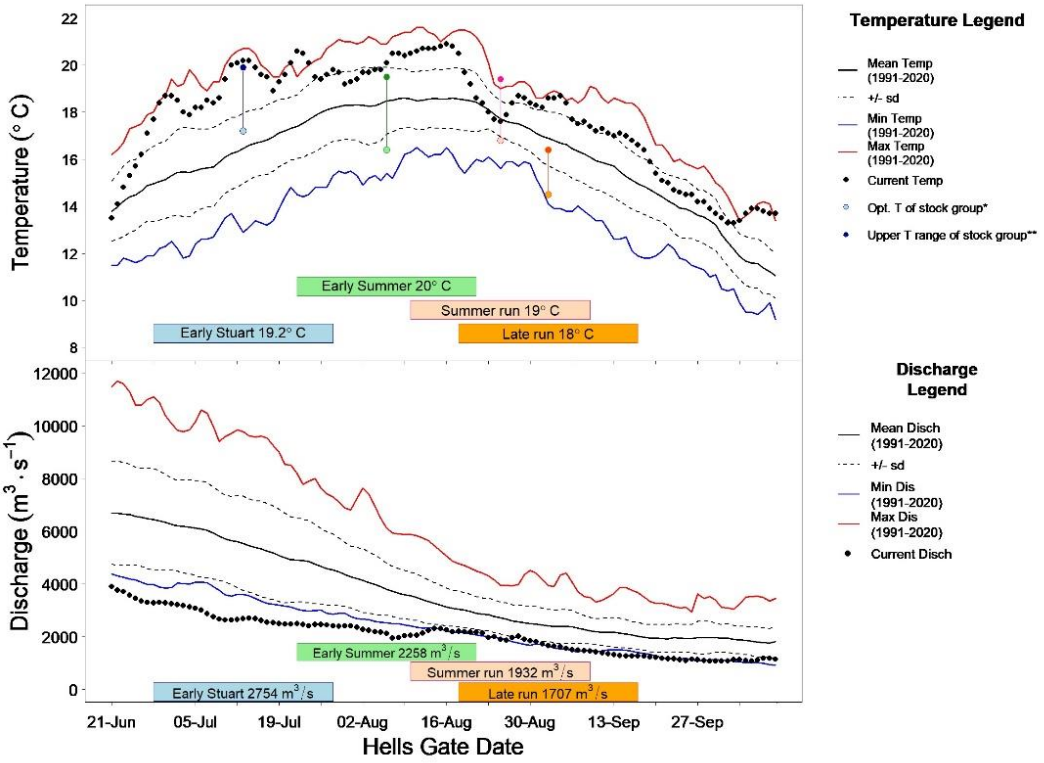

Figure 8. Fraser River temperature and discharge measured near Hope in 2023. Also shown are run timing bars that represent a 31 day spread of the run centred around the Hells Gate date and the mean temperature and discharge for the 31 day spread.

E. Mission Passage

The estimate for upstream passage of Fraser sockeye at Mission was 1,651,000, consisting of 41,000 Early Stuart, 329,800 Early Summer-run (including Pitt), 933,500 Summer-run (including Widgeon), and 346,700 Late-run sockeye (Table 8). The total upstream passage of Fraser River pink salmon at Mission was estimated at 9,579,000. Sockeye and pink passage were estimated using the hydroacoustics monitoring facility at Mission from July 1 to October 2.

The sampling methodology used by the Mission hydroacoustics program to estimate salmon passage was similar to that implemented in recent years: combined observations from a vessel-based mobile split-beam, a vessel-based mobile Adaptive Resolution Imaging Sonar (ARIS), a shore-based (left bank) split-beam, and shored-based ARIS on both right and left banks. Data collection using the vessel-based mobile ARIS was funded as an extension of the 2021/2022 Southern Endowment Fund (SEF) project, and replaced the mobile split-beam as the primary method used for enumeration of offshore passage. Imputation procedures[18] during fisheries opening and cessation of the vessel-based mobile transects were also used in 2023. A detailed account of the 2023 hydroacoustics estimation methodology is provided in Appendix F.

[18] Bzonek, P., Hornsby, R.L, Xie, Y., Nelitz, J., Bartel Sawatzky, M., Martens, F., and Michielsens, C.G.J. 2022. Mission Data Imputation During Fishery Openings: A report to the Southern Boundary Restoration and Enhancement Fund. Pacific Salmon Commission, March 2022.

Table 8. Fraser River sockeye and pink salmon passage at Mission in 2023.

Management Group	Mission Escapement	
Stock Group	fish	%
Early Stuart	**41,000**	**2%**
Early Summer	**329,800**	**20%**
Chilliwack	32,000	2%
Early Miscellaneous	202,700	12%
Early South Thompson	48,300	3%
North Barriere/Taseko	7,600	0%
Pitt[1]	39,200	2%
Summer	**933,500**	**57%**
Raft/N.Thompson	29,400	2%
Chilko	568,600	34%
Quesnel	123,400	7%
Late Stuart/Stellako	161,300	10%
Harrison	50,900	3%
Late	**346,700**	**21%**
Birkenhead	196,500	12%
Late Shuswap/Portage	57,300	3%
Weaver/Cultus	92,900	6%
Total Sockeye	**1,651,000**	**100%**
Pink Salmon	**9,579,000**	**100%**

[1] *Pitt River sockeye do not migrate past Mission, but are shown here as if they did to provide a complete accounting of Fraser sockeye*

V. RUN SIZE, CATCH AND ESCAPEMENT

A. Sockeye Salmon

The total abundance of sockeye salmon in 2023 was 1,692,800 fish (Tables 9 and 10), which is 8% greater than the median forecast of 1,564,000 fish and almost 3 times the total adult return in 2019 (571,000). However, the 2023 return was 59% below the historical cycle line average (4,139,000). By management groups, the return of Fraser sockeye salmon was substantially above forecast for Early Stuart, Early Summer and Late run, but the overall return was similar to forecast (Figure 10) due to the lower than expected return of Summer run sockeye.

All management groups except for the Summer run returned at abundances greater than their median (p50 level) pre-season forecast. The total return of Early Stuart sockeye was 41,200 adults (Table 10), 78% greater than the median forecast. Early Summer-run sockeye returns totalled 334,700 fish, 83% greater than the median forecast level and were dominated by Nadina/Bowron sockeye. The abundance of Summer-run sockeye was 966,000, 20% lower than the median forecast level. Most Summer-run sockeye belonged to the Chilko stock group (576,000), which comprised 34% of the total return to the Fraser River. Returns to all Late-run components were greater than their median forecasts resulting in an aggregate Late-run return of 350,900, which was 88% greater than the group's median pre-season forecast.

Table 9. Catch, escapement, difference between estimates and run size for Fraser River sockeye (by management group) and pink salmon in 2023.

	Fraser Sockeye						Fraser Pinks	
	Early Stuart	Early Summer	Summer	Late	Total	% of Run	Total	% of Run
CANADIAN CATCH	**500**	**3,600**	**24,300**	**300**	**28,700**	**2%**	**528,100**	**5%**
Commercial Catch	**0**	**0**	**0**	**0**	**0**	0%	**443,000**	**4%**
Panel Area	0	0	0	0	0	0%	435,100	4%
Non-Panel Areas	0	0	0	0	0	0%	7,900	0%
First Nations Catch	**0**	**0**	**1,200**	**0**	**1,200**	0%	**7,800**	**0%**
Marine FSC	0	0	0	0	0	0%	2,100	0%
Fraser River FSC	0	0	1,200	0	1,200	0%	4,600	0%
Economic Opportunity	0	0	0	0	0	0%	1,200	0%
Non-commercial Catch	**500**	**3,600**	**23,100**	**300**	**27,500**	2%	**77,300**	**1%**
Marine Recreational	0	0	0	0	0	0%	42,900	0%
Fraser Recreational	0	0	0	0	0	0%	33,700	0%
Charter (Albion & Area 12 Chum)	20	200	400	80	700	0%	600	0%
ESSR	0	1,000	3,200	0	4,200	0%	0	0%
Other Catch***	500	2,400	19,500	200	22,500	1%		
UNITED STATES CATCH	**0**	**30**	**1,200**	**1,200**	**2,400**	**0%**	**428,900**	**4%**
Washington Total	**0**	**30**	**1,200**	**1,200**	**2,400**	**0%**	**428,900**	**4%**
Commercial catch	**0**	**0**	**0**	**0**	**0**	0%	**428,700**	**4%**
Treaty Tribal	0	0	0	0	0	0%	323,000	3%
All Citizen	0	0	0	0	0	0%	105,700	1%
Non-commercial Catch	**0**	**30**	**1,200**	**1,200**	**2,400**	0%	**200**	**0%**
Ceremonial	0	20	1,100	1,100	2,200	0%	200	0%
Recreational	0	0	0	0	0	0%	0	0%
Other Catch***	0	10	80	90	200	0%	0	0%
Alaska**	0	0	0	0	0	0%	0	0%
TEST FISHING CATCH	**200**	**4,000**	**9,900**	**2,600**	**16,700**	**1%**	**14,300**	**0%**
PSC (Panel Areas)	**100**	**3,100**	**6,500**	**1,600**	**11,300**	**1%**	**8,300**	**0%**
Canada	100	3,100	6,500	1,600	11,300	1%	6,000	0%
United States	0	0	0	0	0	0%	2,300	0%
Canada (non-Panel Areas)	**100**	**900**	**3,400**	**1,000**	**5,300**	**0%**	**6,000**	**0%**
TOTAL RUN	**41,200**	**334,700**	**966,000**	**350,900**	**1,692,800**	**100%**	**10,513,300**	**100%**
Total Catch in All Fisheries	700	7,600	35,300	4,000	47,700	3%	971,300	9%
Adult Spawning Escapement *	10,100	185,900	592,900	129,300	918,200	54%	9,542,000	91%
Jack Spawning Escapement	0	1,000	1,100	300	2,500	0%	0	0%
Difference Between Estimates**	30,400	140,200	336,600	217,200	724,400	43%	0	0%
Percentage of Total Run	**100%**	**100%**	**100%**	**100%**	**100%**		**100%**	
Total Catch in All Fisheries	2%	2%	4%	1%	3%		9%	
Spawning Escapement	24%	56%	61%	37%	54%		91%	
Difference Between Estimates	74%	42%	35%	62%	43%		0%	

* Spawning escapement estimates include broodstock collection for Early Stuart, Bowron, Taseko, Late Stuart and Cultus; 239, 46, 44, 88 and 31, respectively.

** Difference between estimates as at the time of the final spawning ground estimates. Also, consistent with Panel advice, positiveDBEs were set to zero for all componenets of management groups.

*** May include unauthorized directed retention or unauthorized bycatch retention in fisheries directed at other species

**** Preliminary Alaska catch totals 7,775 Fraser sockeye

The total sockeye catch of 47,700 represented about 3% of the total return (Tables 9 and 10). This exploitation rate of 3% does not include Alaskan District 104 catch. This exploitation rate is the lowest on record. Of the total sockeye catch, 28,700 fish were caught in Canada, 2,400 fish in the U.S.A (Washington) and 16,700 fish in test fisheries (Table 9). Canadian catches included an ESSR (Excess Salmon to Spawning Requirements) catch of 4,200, Charter catch of 700 and 'other' catch of 22,500. 'Other' catch relates to unauthorized directed retention or unauthorised by catch retention in fisheries directed at other species In Washington State there was no commercial catch taken but

2,200 sockeye were caught in Treaty Tribes Ceremonial and Subsistence fisheries directed at Fraser River pink salmon, and another 200 sockeye were caught as 'other' catch. The preliminary Alaska catch of Fraser sockeye from District 104 was 7,775 fish.

Table 10. Catch, escapement, difference between estimates, run size and exploitation rate for Fraser River sockeye (by stock group) and pink salmon in 2023.

Management Group / Stock Group	Catch	Adult Spawning Escapement	Difference Between Estimates[3]	Abundance			Portion of Run	Adult Exploitation Rate
				Adult	Jack [1]	Total		
Fraser Sockeye Salmon								
Early Stuart	**700**	**10,100**	**30,400**	**41,200**	**0**	**41,200**	**2%**	**2%**
Early Summer-run	**7,600**	**185,900**	**140,200**	**333,700**	**1,000**	**334,700**	**20%**	**2%**
Chilliwack	300	5,400	26,500	32,200	0	32,200	2%	1%
Early Miscellaneous	5,900	137,100	62,300	205,300	1,000	206,300	12%	3%
Early South Thompson	700	17,600	30,400	48,800	0	48,800	3%	1%
North Barriere/Taseko	200	4,200	3,300	7,700	0	7,700	0%	3%
Pitt	500	21,600	17,700	39,700	0	39,700	2%	1%
Summer-run	**35,300**	**592,900**	**336,600**	**964,900**	**1,100**	**966,000**	**57%**	**4%**
Raft/N.Thompson	300	18,900	10,400	29,600	60	29,700	2%	1%
Chilko	25,700	344,600	204,800	575,100	900	576,000	34%	4%
Quesnel	2,900	67,100	54,700	124,700	0	124,700	7%	2%
Late Stuart/Stellako	6,000	128,000	50,200	184,200	200	184,300	11%	3%
Harrison/Widgeon	500	34,300	16,600	51,400	20	51,400	3%	1%
Late-run	**4,000**	**129,300**	**217,200**	**350,600**	**300**	**350,900**	**21%**	**1%**
Birkenhead/BigSilver	1,700	79,500	117,000	198,300	200	198,500	12%	1%
Late Shuswap/Portage	700	11,300	45,900	57,800	30	57,800	3%	1%
Weaver/Cultus	1,600	38,500 [2]	54,300	94,500	100	94,600	6%	2%
Total	**47,700**	**918,200**	**724,400**	**1,690,300**	**2,500**	**1,692,800**	**100%**	**3%**
Portion of Total Run	3%	54%	43%	100%	0%	100%		
Fraser Pink Salmon								
Total	**971,300**	**9,542,000**	**0**	**10,513,300**	**0**	**10,513,300**	**100%**	**9%**
Portion of Total Run	9%	91%	-	100%		100%		

1 Jack ratios were not estimated for fisheries; estimates include only those jacks that were actually sampled and are therefore underestimates.

2 Spawning escapement estimates of Early Stuart, Bowron, Taseko, Late Stuart and Cultus sockeye include 239, 46, 44, 88 and 31 individuals captured as brood stock, respectively.

3 Difference between estimates as at the time of the final spawning ground estimates. Also, consistent with Panel advice, positive DBEs were set to zero for all componenets of management groups.

DFO annually assesses the spawning ground abundance of sockeye populations in the Fraser watershed (Figure 11). In 2023, the near-final estimate of adult spawners (primarily age-4 and age-5 fish) totalled 918,200 fish, or 54% of the total run (Table 10). This escapement was triple the brood year (2019) escapement of 302,900 adults (Figure 9).

Spawner abundances for all management groups were greater than those observed in the brood year (2019, Figure 12). By management group, Early Stuart spawning escapements in 2023 were 113 times higher than the brood year due to the Big Bar rockslide but only 25% of the cycle average escapement. Almost all the returning spawners were 5-year olds (98%). Early Stuart were taken for broodstock from the Matsqui fish wheel (12 sockeye), as well as the natal area (239 sockeye). For Early Summer run, the spawning escapement was more than 4 times greater than the brood year escapement and 35% greater than the cycle average escapement. Broodstock were collected from the

Upper Bowron River (46 sockeye) and Taseko Lake (44 sockeye). For Summer run, spawning escapement was more than double the brood year escapement, but similar to the cycle average. For Late run, the spawning escapement was 12 times greater than the brood year escapement which had been the lowest on record but only 31% of the cycle average escapement.

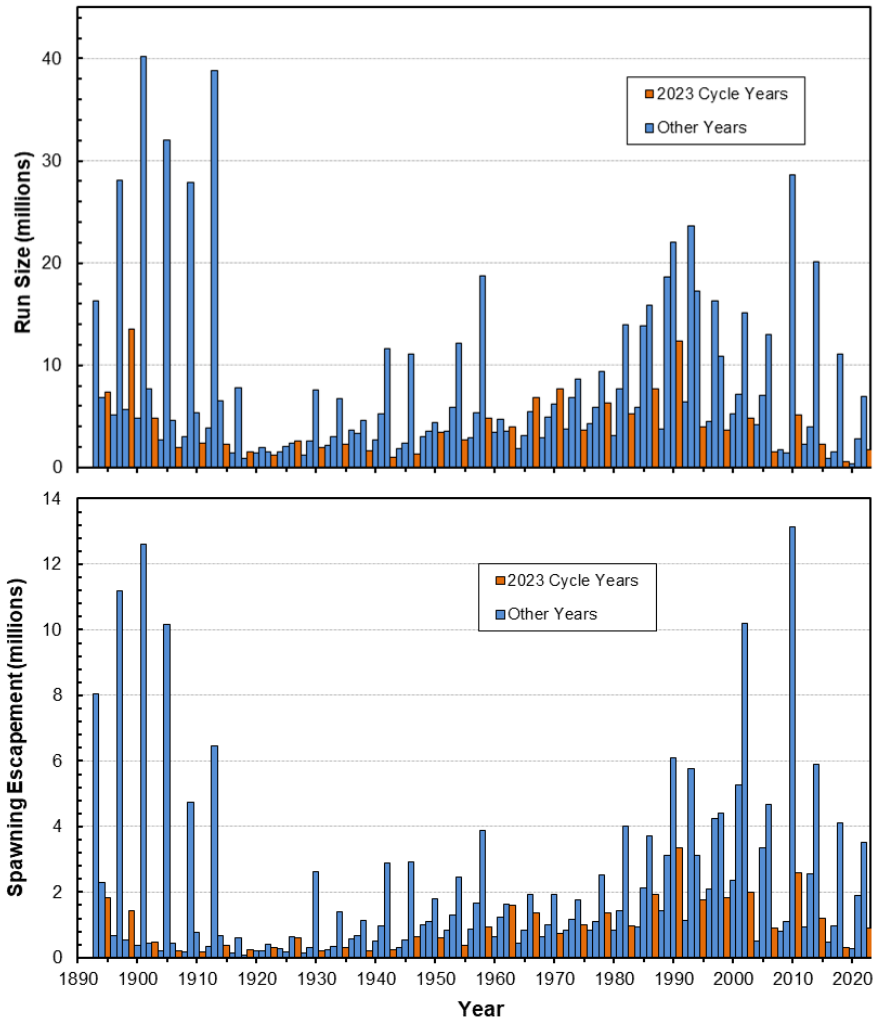

Figure 9. Total run size and spawning escapement of Fraser River sockeye salmon from 1893-2023. Returns on the 2023 cycle are emphasized.

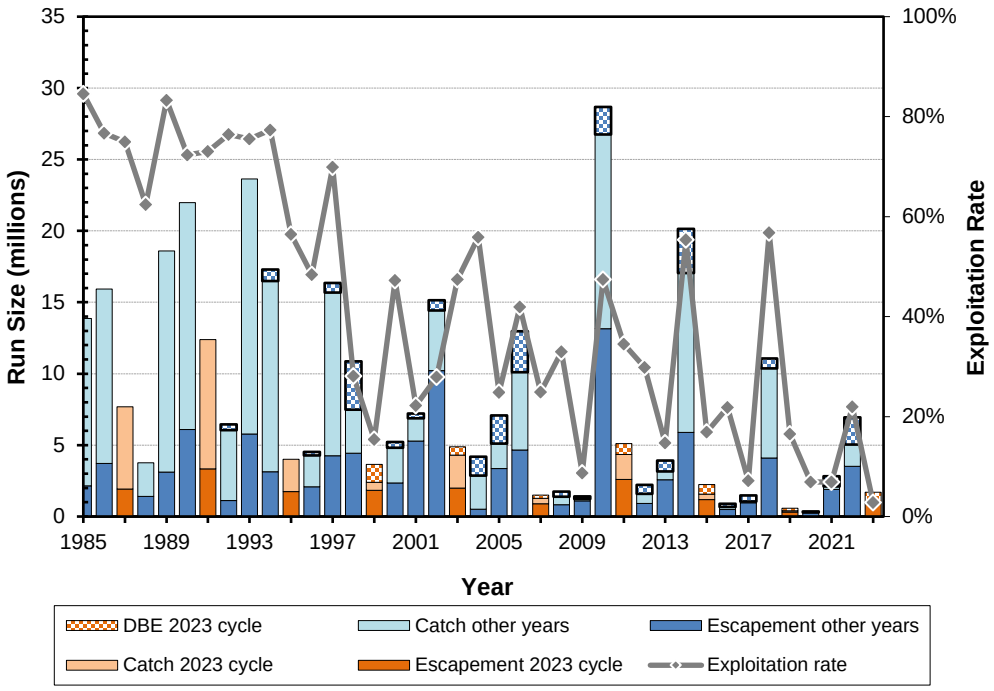

Figure 10. Total catch, escapement, difference between estimates, run size and exploitation rate for Fraser River sockeye salmon in 1985-2023, with returns on the 2023 cycle emphasized.

The overall spawning success of adult female sockeye in the Fraser watershed was 96%. The effective female spawning population in 2023 totalled 524,900 fish, which was 72% greater than the number of effective females in 2019. The DBE[19] was 724,400 fish, or 43% of the total return. As a percentage of run size for each management group, Early Stuart and Late run had the largest DBEs at 74% and 62%, respectively, while the DBEs for Early Summer and Summer run ranged from 35-42% (Tables 9 and 10).

Further details regarding sockeye salmon abundances, catches and spawning escapements including comparisons with the previous four-cycle years can be found in Appendix G (Tables G1 and G3).

[19] In estimates of total return, difference between estimates (DBEs) will eventually be replaced by Run-size Adjustments (RSAs) which are revisions to the total run size in cases when there is evidence that more fish returned than were accounted for in catch and escapement, e.g., evidence of en route mortality, evidence of biased or incomplete estimates of catch, Mission escapement or spawning escapement. The focus of RSAs is on providing the best assessments of total returns, i.e., recruitment. Models that relate recruitment and spawning stock are used to develop both pre-season abundance forecasts and escapement policy. The methods used to estimate RSAs are currently under review by PSC and DFO staff and members of the Fraser River Panel Technical Committee.

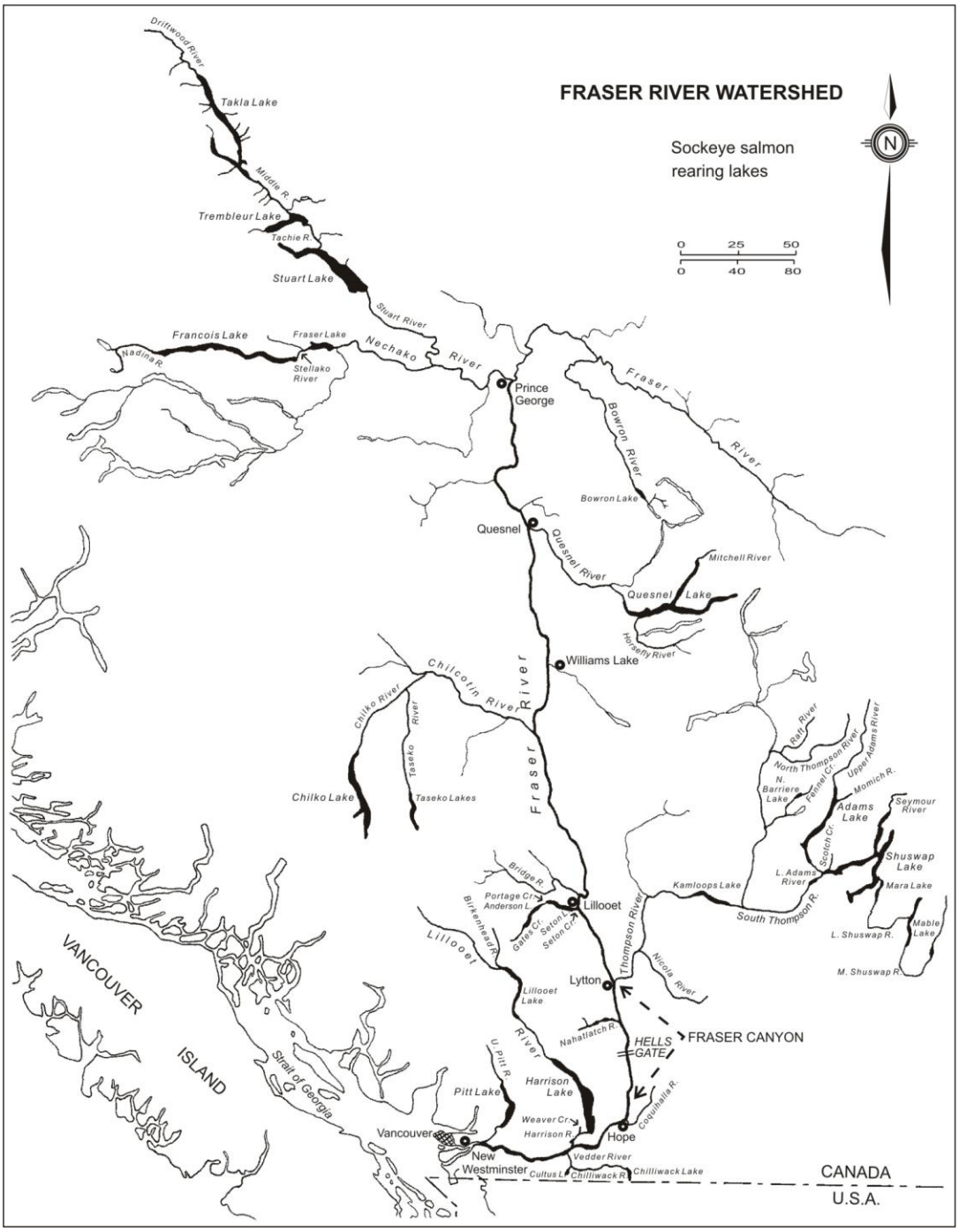

Figure 11. Sockeye salmon spawning areas in the Fraser River watershed.

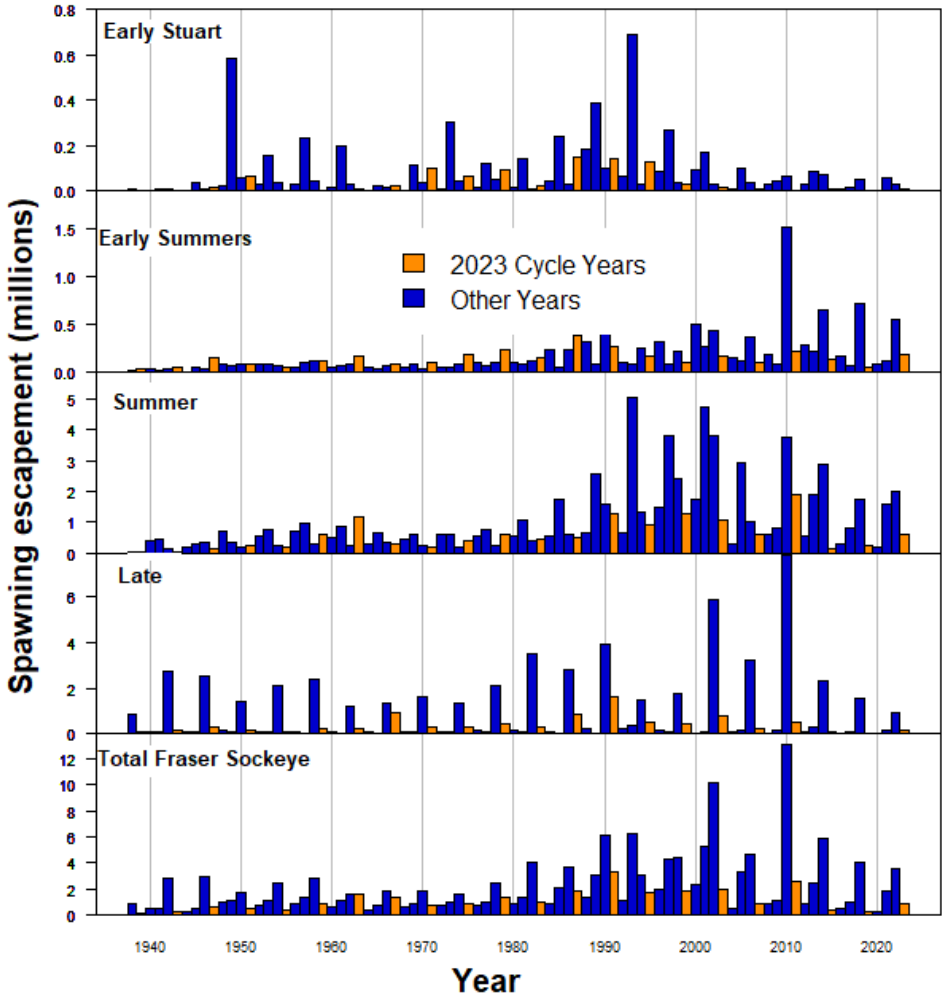

Figure 12. Annual adult spawning escapement of Fraser River sockeye salmon for each management group and for total sockeye in 1938-2023, with escapements on the 2023 cycle emphasized.

B. Pink Salmon

The post-season run-size estimate of 10,513,300 fish (Table 14) was 71% greater than the median pre-season forecast of 6,135,000 fish (Table 1). This estimate was made up of a Mission hydroacoustic passage estimate of 9,579,000 (Table 8) and a catch below Mission estimate of 934,700.

The 2023 return was higher than the return in the brood year (Figure 13), and slightly below the historical average return of 11,500,000. Returns of Fraser pink salmon (Figure 13) have been highly variable over the years, as 2017 was the lowest return since 1965 (3,549,000), while 2003 was one of the highest returns (26,000,000) since records began in 1959. Returns have been relatively stable in the last three cycle years with 8,858,000 fish in 2019, 8,083,000 in 2021, and 10,513,000 in 2023.

The exploitation rate of Fraser River pink salmon in 2023 was 9%, similar to the low exploitation rates (5-10%) observed in 1999-2007 and 2015-2021 and much smaller than the 1959-1989 average exploitation rate of 68% (Figure 13). The low exploitation rates observed were largely a result of conservation concerns for Late-run sockeye that co-migrate with Fraser pink salmon.

These low harvest levels have resulted in substantial spawning escapements of Fraser pinks in recent years. In 2023, although the total sockeye run size was similar to the forecast, it was still low enough that in combination with the uncertainty regarding the pink salmon run size it resulted in constraints on pink-directed fisheries in both countries.

Of the total Fraser River pink salmon catch, 528,100 were caught in Canada, 428,900 in the U.S. and 14,300 in test fisheries (Table 9). The Canadian commercial catch was 443,000 (Table 11), the First Nations catch was 7,800, the non-commercial catch was 77,300 and the Charter catch was 600. The U.S. catch included a commercial catch of 428,700, of which 323,000 were caught in Treaty Tribal fisheries and 105,700 were caught in All Citizen fisheries (Table 12). There was a small catch of 200 pink salmon in a U.S. Treaty Tribes Ceremonial and Subsistence fishery.

Further details on Fraser River pink salmon abundances, catches and spawning escapements including historical production data can be found in Appendix G (Tables G2 and G4).

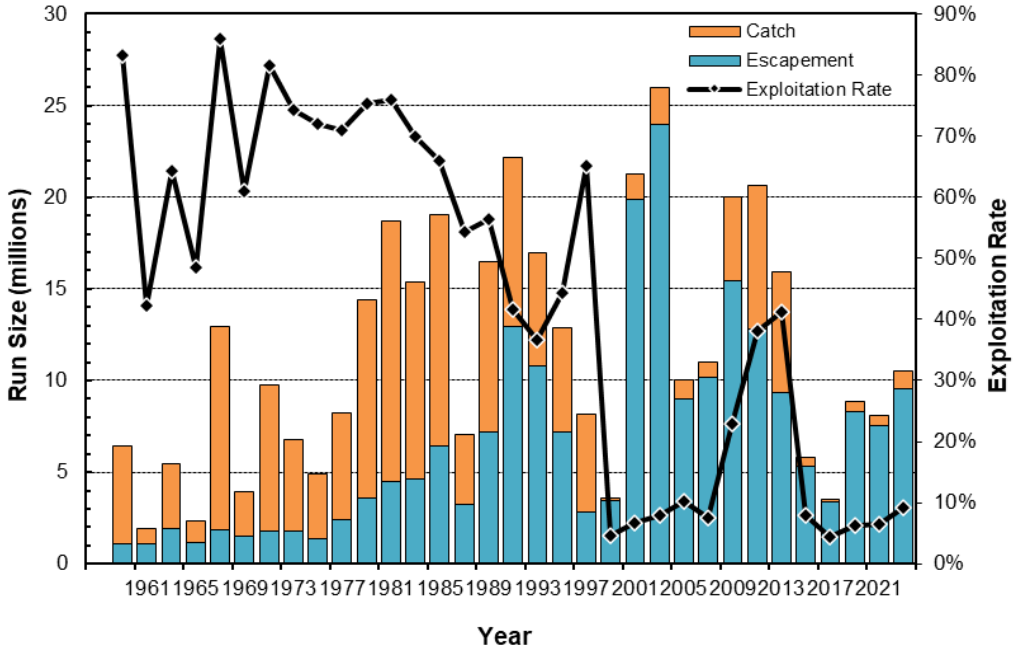

Figure 13. Annual spawning escapement, catch, and exploitation rate for Fraser River pink salmon, 1959-2023.

Table 11. Canadian commercial catches of Fraser River pink salmon by gear type, license designation and statistical area in 2023. Grey areas indicate fishery areas are not part of the license-area designation.

Fishery	Purse Seine		Gillnet			Troll			
Areas	Area A	Area B	Area C	Area D	Area E	Area F	Area G	Area H	Total
Commercial	**0**	**440,300**	**0**	**0**	**0**	**0**	**0**	**2,700**	**443,000**
Panel Areas	**0**	**432,400**	**0**	**0**	**0**	**0**	**0**	**2,700**	**435,100**
20		0			0		0		0
17, 18, 29		432,400			0			2,700	435,100
121-124 *		0		0			0		0
Non-Panel Areas	**0**	**7,900**	**0**	**0**	**0**	**0**	**0**	**0**	**7,900**
1-10	0		0			0			0
11-16		7,900		0	0		0	0	7,900
124-127 *		0		0			0		0
First Nations Economic Opportunity and Demo Fisheries									**1,200**
Total Catch									**444,200**

* Catch in Area 124 is divided between Panel and Non-Panel Areas.

Table 12. U.S. commercial catches of Fraser River pink salmon by user group, gear type and statistical area in 2023.

Areas	Purse Seine	Gillnet	Reefnet	Total
Panel Area (Washington)	**409,400**	**200**	**19,100**	**428,700**
Treaty Tribal *	**323,000**	**0**	**0**	**323,000**
4B, 5 and 6C	0	0	0	0
6 and 7	105,300	0	0	105,300
7A	217,700	0	0	217,700
All Citizen **	**86,500**	**200**	**19,100**	**105,700**
7	2,100	100	19,100	21,200
7A	84,400	100	0	84,500
Non-Panel Area				**0**
United States Total				**428,700**

* Estimates for Treaty Tribal fisheries are from the "TOCAS" database.

** Estimates for All Citizen fisheries are from the WDFW "LIFT" database.

VI. ACHIEVEMENT OF OBJECTIVES

The mandate of the Fraser River Panel is to manage commercial fisheries in Panel Area waters to achieve a hierarchy of objectives. In order of importance, the objectives are to: (1) achieve spawning escapement targets for Fraser River sockeye and pink salmon as determined by the schedule provided by Canada; (2) achieve targets for international sharing of the TAC as defined in the Treaty; and (3) achieve domestic allocation goals within each country. In addition, the Treaty instructs the Panel to plan and manage its fisheries consistent with the provisions of other chapters of Annex IV to ensure that the conservation needs and management requirements for other species and other sockeye and pink salmon stocks are taken into account. Panel management is evaluated after

each season to determine whether the goals were achieved and to identify potential improvements in data collection programs, assessment methods and management techniques. While not formally under Panel control, management of Canadian non-Panel fisheries directed at Fraser River sockeye and pink salmon is based on the same in-season information and hierarchy of objectives, with priority given first to conservation, and then to First Nations Food, Social and Ceremonial (FSC) harvest within Canada's allocation.

A. Escapement

The Panel's first task is to achieve spawning escapement targets by stock or stock grouping. Spawning escapement targets were determined by applying Canada's spawning escapement plan to abundance estimates for each management group or to the total return in the case of Fraser River pink salmon. Pre-season, all management groups were constrained by a LAER of 10%. In-season, run size abundances were greater than the pre-season forecast, with the exception of the Summer run. However, all management groups were still constrained by the LAER. and catches were a result of fisheries directed at other co-migrating stocks.

In-season monitoring of the progress toward spawning escapement targets is not directly measurable because in most cases spawner abundances cannot be assessed on the spawning grounds until well after the fishing season has ended. In-season management is therefore based on targets for potential spawning escapement (i.e., PSE target = in-season spawning escapement target + MA). Progress towards these targets is monitored by comparison with in-season PSE estimates (i.e., Mission escapement to-date minus catch above Mission). Final in-season PSE estimates indicate the in-season PSE targets were almost reached for every management group: Early Stuart (2% under), Early Summer (2% over), Summer run (3% under), Late run (3% under) (Table 13).

Table 13. Comparison of in-season targets and in-season estimates of potential spawning escapement (PSE) for adult Fraser River sockeye salmon in 2023.

	Final	Potential Spawning Escapement (PSE)					
Management Group	In-season Abundance Estimate	Spawning Escapement Target	Management Adjustment *	In-season PSE ** Target	PSE *** Estimate	Difference Fish	Difference %
Adult sockeye	**1,652,000**	**1,430,000**	**758,700**	**1,652,000**	**1,622,000**	**-30,000**	**-2%**
Early Stuart	41,000	41,000	69,700	41,000	40,000	-1,000	-2%
Early Summer	326,000	163,000	176,000	326,000	332,000	6,000	2%
Summer	926,000	926,000	213,000	926,000	901,000	-25,000	-3%
Late	359,000	300,000	300,000	359,000	349,000	-10,000	-3%

* Adjustment of spawning escapement targets to achieve spawning escapement goals.

** Spawning escapement target + MA. If the spawning escapement target + MA exceeds the total abundance, then the target equals the total abundance.

*** Mission passage minus all catch above Mission.

In terms of the achievement of post-season objectives, the total spawning ground escapement estimate of Fraser sockeye was 38% below the target, while the estimated escapement of Fraser River pink salmon was 59% greater than its target (Table 14). The spawning escapement targets for Early Stuart and Summer run equalled their in-season run sizes while the Late-run run size (350,900) exceeded the target (300,000). For these three management groups the escapement targets were unattainable given the predicted en route losses. Terminal spawning ground escapement estimates were below target by 75%, 39% and 57% for Early Stuart, Summer, and Late run, respectively, but exceeded the target for Early Summer run by 11% (Table 14). The harvest of Fraser sockeye only contributed to a limited extent to this failure to meet spawning escapement targets for Early Stuart, Summer and Late run as the exploitation rate, excluding Alaska D104 sockeye catch, for these three

management groups was substantially below the 10% LAER: Early Stuart (2%), Summer run (4%) and Late run (1%).

Table 14. Comparison of post-season spawning escapement targets and escapement estimates for adult Fraser River sockeye salmon in 2023. Post-season estimates of sockeye escapement are from spawning ground enumeration programs (DFO). Post-season estimate of pink escapement based on Mission hydroacoustics.

Management Group	Post-season Run-size Estimate	Spawning Escapement			
		Post-season Target	*Adult Estimate	Difference	
				Fish	%
Sockeye salmon	**1,692,800**	**1,474,600**	**918,200**	**-556,400**	**-38%**
Early Stuart	41,200	41,200	10,100	-31,100	-75%
Early Summer	334,700	167,400	185,900	18,500	11%
Summer	966,000	966,000	592,900	-373,100	-39%
Late	350,900	300,000	129,300	-170,700	-57%
Pink salmon	**10,513,300**	**6,000,000**	**9,542,000**	**3,542,000**	**59%**

* Escapement estimates include 239, 46, 44, 88, and 31 Early Stuart, Bowron, Taseko, Late Stuart and Cultus fish kept for broodstock, respectively.

Although the total sockeye returns in 2023 were as expected and three times as large as returns in 2019 , they were still well below the cycle line averages and reflect a continuing trend of declining productivity that is a growing concern.[20] Currently the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) considers eight Fraser River sockeye stocks as endangered (Early Stuart, Bowron, Taseko, Late Stuart, Quesnel, Portage, Weaver, Cultus) and two as threatened (Upper Barriere, Widgeon).[21] Of these stocks, Early Stuart, Bowron, Taseko, Quesnel and Late Stuart all have spawning grounds above Big Bar.

For Fraser River pink salmon, the spawning escapement estimate was 59% above the target (Table 14) and the exploitation rate was 9% (Table 10). This was due to in-season challenges related to determining the run size for Fraser pink salmon and to the fact that access to pink salmon TAC had been restricted as all sockeye management groups were being managed with a LAER at the time of pink directed fishery openings.

B. International Allocation

The Panel's second priority is to achieve the international allocation goals for Fraser sockeye and pink salmon. In accordance with Annex IV, Chapter 4 of the Pacific Salmon Treaty, the TAC calculations are based on the run sizes, spawning escapement targets and MAs in effect when the Panel last adopted a run size in-season (September 27). This agreement is reflected in the revised 2020 Chapter 4, Annex IV of the Pacific Salmon Treaty. The test fishing catch and Aboriginal Fisheries Exemption deductions used in this calculation are the post-season estimates, however.

Given the low run sizes in 2023, there was no international TAC for Fraser River sockeye in-season (Figure 15). Due to the catch of 2,210 sockeye in Washington in pink salmon directed

[20] DFO. 2020. Recovery Potential Assessment for Fraser River Sockeye Salmon (*Oncorhynchus nerka*) – Nine Designatable Units – Part 1: Probability of Achieving Recovery Targets. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2020/012.

[21] COSEWIC. 2017. COSEWIC assessment and status report on the Sockeye Salmon *Oncorhynchus nerka*, 24 Designatable Units in the Fraser River Drainage Basin, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xli + 179 pp.

fisheries where sockeye bycatch retention was permitted, the United States exceeded its sockeye share by 2,210 fish (Table 16). In addition, there was a catch of 200 'other' fish in pink directed fisheries when no sockeye bycatch retention was permitted. Canada's catch of 24,500 Fraser sockeye, which excludes ESSR catch, was largely from First Nations catch, 1,200, as well as 'other' catch, 22,500, which was associated with unauthorized directed retention or unauthorized bycatch retention in fisheries directed at other species. A detailed version of the TAC calculations by management group is presented in Appendix G, Table G5.

Table 15. Total allowable catch (TAC) and achievement of international catch shares for Fraser River sockeye and pink salmon in 2023. TAC calculations use the in-season estimates of run size, spawning escapement target and management adjustment at the time of the last adopted run size at an in-season Panel meeting (September 27), in accordance with the revised Annex IV, Chapter 4 of the Treaty agreed to January 2020.

		Sockeye		Pink	
TOTAL ALLOWABLE CATCH					
In-season Total Run Size		**1,652,000**		**10,300,000**	
Deductions		**2,205,400**		**6,014,300**	
In-season Spawning Escapement Target		1,430,000		6,000,000	
In-season Management Adjustment		758,700		n/a	
Aboriginal Fishery Exemption (AFE)		0		n/a	
Post-season Test Fishing Catch		16,700		14,300	
Total Allowable Catch	*1, 2*	**0**		**4,285,700**	
UNITED STATES					
Washington Total Share	*3*	**0**		**1,101,400**	
Washington Share of TAC	*1*	0	16.5%	1,101,400	25.7%
Payback		0		0	
Washington Catch		**2,200**		**428,900**	
Other Catch		**200**			
Deviation		**-2,400**		**672,500**	
In-season Alaska Catch Estimate		0		0	
CANADA					
Canadian Share of TAC + U.S. Payback + AFE		**0**		**3,184,300**	
Canadian Catch (excluding ESSR & Other Catch)		**1,900**		**528,100**	
Other Catch	*4*	**22,500**			
Deviation (excluding ESSR)		**-24,500**		**2,656,200**	

1 TAC and Washington sockeye share according to Annex IV, Chapter 4 of the Pacific Salmon Treaty.

2 TAC may not equal the total run minus total deductions shown due to adjustments required when the run size of individual management groups is less than the nominal deductions. A more detailed TAC calculation showing these intermediate calculations is shown in the Appendix.

3 United States share according to revised Annex IV of the Pacific Salmon Treaty:
Sockeye: 16.5% of the TAC - payback (maximum 5% of share).
Pink: 25.7% of the TAC - payback (maximum 5% of share).

4 May include unauthorized directed retention or unauthorized bycatch retention in fisheries directed at other species

The TAC for Fraser pink salmon was 4,285,700 fish, with a U.S. share of 1,101,400 fish (25.7%) and Canadian allowable harvest of 3,184,300 fish (Table 15). Both the U.S.A and Canada caught less than their allocation. Access to pink salmon TAC had been restricted due to all sockeye management groups being managed with a LAER at the time of U.S. and Canadian pink salmon directed fisheries and the fact that the pink salmon run size was increased when most of the salmon had already exited marine fishing areas.

C. Domestic Allocation

The third priority of the Panel is to achieve domestic allocation goals as specified by the Parties. While the Panel manages all commercial fisheries directed at Fraser River sockeye and pink salmon in Panel Area waters (Figure 1), Canada has sole responsibility for regulating fisheries including commercial net and troll fisheries in non-Panel areas such as Johnstone Strait, and First Nations and recreational fisheries in all fishing areas.

In the U.S., Treaty Tribes fishers caught 2,210 sockeye which exceeded the U.S. sockeye salmon TAC of zero fish (Table 16). For Fraser River pink salmon, Treaty Tribes and All Citizen fishers caught less than their domestic share of the U.S. pink salmon TAC, 227,500 and 445,000 under, respectively (Table 17).

Table 16. Achievement of domestic catch goals in Washington for Fraser River sockeye salmon in 2023.

	Actual Catch		Share of TAC		
User Category	Fish	%	Fish	%	**Deviation**
Washington Total	**2,410**	**100.0%**	**0**	**100.0%**	**2,410**
Treaty Tribal *	2,210	91.7%	0	67.7%	2,210
All Citizen **	0	0.0%	0	32.3%	0
Other ***	200	8.3%	0		200

* Treaty Tribal catch includes commercial and ceremonial catches.

** All Citizen catch includes commercial and recreational catches.

*** Unauthorized directed retention or unauthorized bycatch retention in fisheries directed at other species.

Table 17. Achievement of domestic catch goals in Washington for Fraser River pink salmon in 2023.

	Actual Catch		Share of TAC		
User Category	Fish	%	Fish	%	**Deviation**
Washington Total	**428,900**	**100.0%**	**1,101,400**	**100.0%**	**-672,500**
Treaty Tribal *	323,200	75.4%	550,700	50.0%	-227,500
All Citizen **	105,700	24.6%	550,700	50.0%	-445,000

* Treaty Tribal catch includes commercial and ceremonial catches.

** All Citizen catch includes commercial and recreational catches.

In Canada, First Nations catch and 'other' sockeye catch (unauthorized directed retention or unauthorized bycatch retention in fisheries directed at other species) accounted for 1,200 and 22,500 fish, respectively. Commercial, First Nations fisheries and recreational fisheries were directed towards Fraser pink salmon and together harvested 527,500 fish which was less than Canada's balance of the international TAC (Tables 9, 15). Marine and in-river recreational fisheries accounted for 42,900 and 33,700 in pink salmon catch, respectively. An additional 700 Fraser River sockeye and 600 Fraser River pink salmon were caught in domestic, Chinook and chum test fisheries.

D. Conservation of Other Stocks and Species

Non-target stocks and species are caught in Panel Area fisheries directed at Fraser River sockeye and pink salmon. The conservation needs and management requirements for these stocks and species caught incidentally in fisheries regulated by the Fraser Panel are taken into account through a variety of bilateral and domestic processes associated with the implementation of Chapter 4 (Fraser River sockeye and pink salmon) and other Chapters of Annex IV. A comprehensive summary of all the methods in which bycatch impacts are taken into account is beyond the scope of this report, but we provide a few examples below. In the United States, the Pacific Fishery Management Council takes into account modelled bycatch of Chinook and coho salmon in Fraser Panel regulated sockeye and pink-directed fisheries to ensure consistency with Chapters 3 (Chinook) and 5 (coho) of Annex IV. Similarly, Canada, through its Integrated Fisheries Management Plan for South Coast salmon fisheries, specifies closure windows for sockeye and pink-directed fisheries in the Fraser River and these closures are regularly implemented to protect Chinook and coho salmon. There was no bycatch of non-Fraser sockeye salmon, but there was a bycatch of 211,100 non-Fraser pink salmon in commercial net fisheries regulated by the Fraser River Panel. Catches of other Fraser and non-Fraser salmon species included 9,570 Chinook, 3,380 coho, 10 chum, and zero steelhead (Table 18).

Table 18. Catches of non-Fraser sockeye and pink salmon and catches of other salmon species in commercial fisheries regulated by the Fraser River Panel in 2023.

	Non-Fraser		Fraser and Non-Fraser			
Area and Gear	Sockeye	Pink	Chinook	Coho	Chum	Steelhead
United States *	**0**	**132,140**	**9,560**	**3,320**	**10**	**0**
Areas 4B, 5 and 6C Net	0	0	0	0	0	0
Areas 6, 7 and 7A Net	0	132,140	9,560	3,320	10	0
Canada **	**0**	**78,960**	**10**	**60**	**0**	**0**
Area 20 Net	0	0	0	0	0	0
Area 29 Net	0	78,960	10	60	0	0
Total	**0**	**211,100**	**9,570**	**3,380**	**10**	**0**

* Estimates for All Citizen fisheries are from the WDFW "LIFT" database, while estimates for Treaty Tribal fisheries are from the "TOCAS" database.

** Estimates are from DFO in-season hail program.

VII. ALLOCATION STATUS

Annex IV, Chapter 4, (paragraph 8 (c)(iv)) specifies that *the U.S. share will not be adjusted for an overage resulting from TAC reductions after the scheduling of the last Fraser River Panel approved U.S. fishery of the season.* The resulting calculations indicate there was an overage for Fraser River sockeye in 2023 (Table 19). The Panel agreed that the 2,390 sockeye landed in Panel regulated fisheries directed at Fraser River pink salmon in 2023 would be carried over as payback to 2024. The resulting calculations also indicate there was no payback due for Fraser River pink salmon in 2023 (Table 19).

Table 19. Allocation status for Fraser River sockeye and pink salmon in 2019-2023.

Sockeye Salmon	2019 (Sep 13)	2020 (Sep 1)	2021 (Sep 28)	2022 (Aug 18)	2023 (Sept 27)
TOTAL ALLOWABLE CATCH					
Total Run Size	500,000	293,000	2,553,000	7,274,000	1,652,000
Escapement and other deductions	500,000	293,000	2,377,260	4,940,480	1,652,000
Total Allowable Catch:	0	0	175,740	2,333,520	0
UNITED STATES					
Washington Catch	470	0	20	352,310	2,390
Washington Share (excl ds payback)	0	0	29,000	385,030	0
Deviation:	470	0	-28,980	-32,720	2,390
Cumulative Allocation Status:	**470****	**470****	**470****	**0****	**2,390****
CANADA					
Catch	9,860	11,360	80,230	1,082,410	24,450
Share + Aboriginal Exemption	9,710	11,290	546,740	2,053,737	0
Deviation:	150	70	-466,510	-971,327	24,450

Pink Salmon	2019 (Sep 13)	2021 (Sep 28)	2023 (Sep 27)
TOTAL ALLOWABLE CATCH			
Total Run Size	8,900,000	8,000,000	10,300,000
Escapement and other deductions	6,017,240	6,004,320	6,014,270
Total Allowable Catch:	2,882,760	1,995,680	4,285,730
UNITED STATES			
Washington Catch	233,290	195,970	428,930
Washington Share	740,870	512,890	1,101,430
Deviation:	-507,580	-316,920	-672,500
Cumulative Allocation Status:	0	0	0
CANADA			
Catch	300,260	79,780	528,060
Share	2,141,890	1,482,790	3,184,300
Deviation:	-1,841,630	-1,403,010	-2,656,240

** Washington share of the TAC according to Annex IV of the Pacific Salmon Treaty:

2019: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks. As there was no TAC for sockeye salmon, any sockeye caught in pink-directed fisheries generated an overage

2020: No payback was generated in 2020, but by Panel agreement 470 sockeye were carried forward from the 2019 season

2021: No payback was generated in 2021, but by Panel agreement 470 sockeye were carried forward from the 2019 season

2022: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks. Allocation status based on TAC when Panel made the last decision about U.S. fisheries in 2022 (Aug 18).

2023: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks. As there was no TAC for sockeye salmon, any sockeye caught in pink-directed fisheries generated an overage.

VIII. POST-SEASON REVIEW

During Fraser River Panel regulatory control in 2023, the United States prosecuted fisheries that Canada objected to under the provisions of Annex IV, Chapter 4, paragraph 13(d)(iii), on August 18 and August 25, 2023. Pursuant to the same paragraph, the United States provided rationale for these fisheries via correspondence to the PSC Executive Secretary, Mr. John Field, on August 19, 2023 (U.S. rationale, Appendix H) and on August 25, 2023 (U.S. rationale, Appendix H). On October 6, 2023, the Panel's Canadian Chair sent a response to the rationale letters to the Panel's U.S. Vice Chair (Canadian response, Appendix H). The same day, Canada corresponded with the Executive Secretary requesting an objective report on the circumstances of the fishery and its consequences pursuant to Chapter 4, paragraph 13(e) (Canadian report request, Appendix H). This report (Appendix H) prepared by staff was submitted to the panel December 2023 and reviewed at the PSC

January 2024 post-season meeting. The report contained 12 recommendations to be considered by the panel. The panel's response to the report (Appendix I) provided the perspective of both countries as well as a bilateral response to the recommendations at the February 2024 annual meeting.

IX. APPENDICES

APPENDIX A: GLOSSARY OF TERMS AND ABBREVIATIONS

Bayesian Methods and Models: Statistical models which allow pre-season forecasts of run size, diversion rate, and migration timing to be used as priors and then combined with in-season observations as data accumulates over the course of the season. Early in the season, estimates are heavily dependent on these pre-season priors, but this dependence shifts to the collected data as the season progresses. Uncertainty in the in-season estimates of run size, migration timing and diversion rate decreases as more data become available. The name "Bayesian" comes from the frequent use of Bayes' theorem in the inference process which specifies how the prior and in-season data interact in the generation of estimates.

CPUE: Catch per unit of effort. Typically associated with data obtained from test fisheries (e.g., number of fish caught per 100 fathom minutes (a measure of net size and soak time)).

Cycle line: A series of years associated with a cohort of Fraser sockeye assuming spawners are 4 years old. A cycle line of a particular year includes every 4th year (e.g., 2008, 2012, 2016).

Demonstration fishery: A Canadian commercial fishery designed to test particular gear configurations or explore the feasibility of harvests either in non-traditional areas or by non-traditional gear. A limited number of licenses are typically granted to permit the conduct of such fisheries.

Difference between estimates (DBE): Difference between estimates of spawning escapement (PSE) and potential spawning escapement (SE) (DBE=SE-PSE). The potential spawning escapement is defined as Mission escapement minus any in-river catch that occurs between Mission and the spawning areas. Sources for DBEs include en route mortality and errors (bias and imprecision) introduced through the estimates of Mission escapement, spawning ground escapement, First Nations and recreational catches above Mission, and stock composition. Historical DBE values are used to generate Management Adjustment (MA) models, which use estimates of migration timing and river conditions to predict the DBEs likely to be observed in the current year. The proportional DBE (pDBE) is estimated by dividing the difference between estimates by the potential spawning escapement (pDBE = DBE/PSE) and is often shown as a percentage, such that %DBE = 100 * pDBE. The formulas pDBE = (1/(1+pMA))-1, and pMA= (1/(1+pDBE)-1 can be used to convert between pDBEs and pMAs.

Northern Diversion rate: Proportion of the salmon run that migrates through Johnstone Strait (northern approach) as opposed to Juan de Fuca Strait (southern approach). Estimates may be in time steps of a week or a few days, or a value for the entire migration on an annual basis.

Economic Opportunity (EO) fishery: Commercial Fraser River First Nations fishery in the Lower Fraser area.

Effective Female Spawners: The total number of female spawners multiplied by a measure of spawning success that relates to the fraction of females subsampled in a population that either died with all of their eggs (0% spawning), none of their eggs (100% spawning success) or with an intermediate fraction of their eggs (50% spawning success). Carcass surveys conducted on the spawning grounds endeavour to representatively sample a portion of the available carcasses and assign them to one of the above three categories.

ESSR: Terminal harvest of salmon that are "Excess Salmon to Spawning Requirements". This term is usually associated with fish that are surplus to those needed to completely seed an artificial spawning channel and in the Fraser are most frequently associated with sockeye and the spawning channel at Weaver Creek.

Fishery-induced Mortality (FIM) or Release Mortality: In fisheries where some component of the catch is released (e.g., non-retention), some proportion of the released fish are expected to die due to the stress of capture and handling. These mortalities are referred to as fishery-induced mortality or release mortality.

Fishery Planning Model: A pre-season model that allows the Panel to evaluate the impacts of various fishery options on the achievement of management objectives, given pre-season expectations such as abundance, stock composition, migration timing, diversion rate, spawning escapement targets, management adjustments and catch objectives.

Food, Social and Ceremonial (FSC) fishery: Non-commercial First Nations fishery.

Low Abundance Exploitation Rate (LAER): The purpose of managing a sockeye management group in a LAER situation is to permit bycatch of that stock group in fisheries directed at other management groups or species with available surpluses (e.g., Summer-run sockeye, pink salmon). The application of a LAER for a management group has the effect of limiting the exploitation rate (ER) of that group to a small amount (e.g., 10% or 20% of a run timing group). The need to implement a LAER for a particular sockeye management group can be caused by one of the following:

- When the run size is below the lower fisheries reference point as defined by Canada's Spawning Escapement Plan.
- When the escapement goal plus the management adjustment (MA) is greater than the run size.
- When the escapement goal plus the MA is less than the run size but the resulting ER is less than the % LAER.

Management Adjustment (MA): Additional fish added to an escapement target for the purpose of increasing the likelihood of achieving the escapement target. Pre-season, MAs are typically calculated based on historical discrepancies or long-range forecasts of river conditions. In-season the MAs for Early Stuart, Early Summer-run and Summer-run sockeye stocks are calculated using models that relate historical discrepancies to river conditions. Estimates of migration timing and river conditions in the current year are then used to predict the proportional management adjustments (pMA) that are applied to spawning escapement targets. For Late-run stocks, MAs are often calculated based on models that relate historical discrepancies to upstream timing. The pMAs are multiplied by the spawning escapement targets to calculate numerical MAs. MAs are calculated pre-season as inputs for pre-season planning, and at regular intervals during the fishing season based on in-season estimates of migration timing and observed and forecasted river conditions.

Management group or Run-timing group: Aggregates of sockeye salmon stocks that are used in Fraser Panel management, i.e., Early Stuart, Early Summer-run, Summer-run, and Late-run groups.

Migration date or 50% date: Dates when half (50%) of the total run would have passed a certain geographical location if it is assumed that all fish migrated via that route.

Area 20 date: An index of marine migration timing, assuming the entire run migrated through Canadian fishery management Area 20 in Juan de Fuca Strait.

Mission date: An index of in-river migration timing, defined by when half the total Mission escapement (usually identified by individual stock or stock group) is estimated to have passed Mission.

Reconstructed Mission date: An index of in-river migration timing based on when half of the total reconstructed run to Mission (Mission escapements plus catches seaward of Mission) is estimated to have been available to pass Mission. Reconstructed Mission dates are generally not available for Late-run stocks for which a portion of the run is expected to delay prior to entering the Fraser River.

Mission Escapement or Mission Passage: PSC estimates of the daily number of fish that migrate upstream past the hydroacoustic field station at Mission, B.C. Mission passage is primarily estimated by hydroacoustic methods, but at times (usually early and late in the season) is estimated by dividing the CPUE by catchability using data from in-river test fisheries.

Non-retention: In fisheries where one species is targeted but bycatch of a second species is expected, regulations may specify that the fish of the second species be released. For example, sockeye salmon were expected to be caught in some pink-directed fisheries in 2015 but there was minimal TAC for Late-run Fraser sockeye remaining, so some fisheries were opened for pink salmon harvest, but under conditions of either mandatory or voluntary non-retention for sockeye. Non-target species that are released are assigned gear-specific fishing induced mortality rates (FIMs; see above), that are accounted for along with landed catches in estimates of total exploitation rates.

Potential Spawning Escapement (PSE)

> **Potential spawning escapement target**: In-season target for PSE by management group, where the PSE is the sum of the spawning escapement target plus the Management Adjustment (MA). May also be called the "Adjusted Spawning Escapement target". The management objective is to achieve the PSE target in-season as measured by the potential spawning escapement.
>
> **Potential spawning escapement**: Mission escapement estimate minus in-river catch upstream of Mission. If there were no en route mortalities or estimation errors in Mission escapement, up-river catch, spawning escapement or stock identification, the potential spawning escapement would in theory equal the number of fish estimated to have reached the spawning areas.

Run size: Total abundance or total return of a stock, management group or entire population of Fraser River sockeye or pink salmon.

Run-size Adjustment (RSA): Adjustments to the total return in cases when there is evidence that the number of fish returning deviate from that accounted for in catch and escapement, e.g., evidence of en route mortality, evidence of biased or incomplete estimates of catch, Mission escapement or spawning escapement.

Spawning Escapement (SE)

> **Spawning escapement or Net escapement**: Spawning escapement of adult male and female spawners and jack spawners (precocious age 3 males) as estimated through assessment programs conducted on the spawning grounds, or projected from other data when such programs are not conducted in all areas (e.g., a portion of Quesnel spawners was not assessed on the spawning grounds in 2002). Such escapement numbers include losses from pre-spawn mortality on the spawning grounds, however, pre-spawn mortality (fraction of females which die but retain some portion of their eggs) is accounted for in estimates of effective female spawners.
>
> **Spawning escapement target**: Target for total adult spawning escapement for each spawning population as defined each year by Canada's Spawning Escapement Plan.

Total Allowable Mortality rule (TAM rule): For each Fraser sockeye management group at different run sizes, Canada's Spawning Escapement Plan specifies the total allowable mortality from all sources, including fishery removals (catch) and en route mortality (represented by the Management Adjustment).

List of abbreviations:

ADFG: Alaska Department of Fish and Game	JS: Johnstone Strait
AFE: Aboriginal Fishery Exemption	LAER: Low Abundance Exploitation Rate
ARIS: Adaptive Resolution Imaging Sonar	LGL: A biological consulting company
BC: Province of British Columbia	MA: Management Adjustment
CPUE: Catch per Unit of Effort	MLP: Mandatory Landing Program
DBE: Difference Between Estimates	M-R: Mark-Recapture
DFO: Fisheries and Oceans Canada	pMA: Proportional Management Adjustment
DIDSON: Dual-frequency IDentification SONar	PSC: Pacific Salmon Commission
EO: Economic Opportunity	PSE: Potential Spawning Escapement
ESSR: Excess Salmon to Spawning Requirements	RSA: Run Size Adjustment
FRP: Fraser River Panel	SE: Spawning Escapement
FRPTC: Fraser River Panel Technical Committee	SET: Spawning Escapement Target
FRSSI: Fraser River Sockeye Spawning Initiative	TAC: Total Allowable Catch
FSC: "Food, Social and Ceremonial"	TAM: Total Allowable Mortality
	WDFW: Washington Department of Fish and Wildlife

APPENDIX B: 2023 PRE-SEASON FORECASTS AND SPAWNING ESCAPEMENT TARGETS FOR FRASER RIVER SOCKEYE AND PINK SALMON

Table B1. Pre-season forecasts for Fraser River sockeye and pink salmon in 2023. (Provided to the Panel by Fisheries and Oceans Canada).

Run timing group / Stocks	Forecast Model	Probability that Return will be at/or Below Specified Run Size				
		10%	25%	50%	75%	90%
Early Stuart	*Ricker (Ei)4/Sibling5*	6,000	11,000	23,000	46,000	86,000
Early Summer Total		47,000	81,000	186,000	354,000	665,000
Total excluding misc. stocks		40,000	71,000	141,000	284,000	552,000
Bowron	*Ricker (Pi)*	100	400	2,000	6,000	15,000
Upper Barriere (Fennell)	*Ricker (Pi)4/Sibling5*	700	1,000	2,000	5,000	9,000
Gates	*LLY4/Sibling5*	3,000	6,000	12,000	25,000	48,000
Nadina	*RickerCyc4/Sibling5*	19,000	37,000	76,000	157,000	315,000
Pitt	*Larkin4/Sibling5*	12,000	19,000	31,000	49,000	77,000
Scotch	*Larkin4/Sibling5*	3,000	5,000	11,000	23,000	42,000
Seymour	*Ricker(Pi)*	2,000	3,000	7,000	19,000	46,000
Misc (EShu)	*R/S*	7,000	9,000	41,000	64,000	100,000
Misc (Taseko)	*R/S*	0	0	10	10	10
Misc (Chilliwack)	*R/S*	300	400	2,000	3,000	6,000
Misc (Nahatlatch)	*R/S*	300	500	2,000	3,000	7,000
Summer Total		349,000	614,000	1,167,000	2,398,000	4,405,000
Total excluding misc. stocks		349,000	614,000	1,166,000	2,396,000	4,401,000
Chilko	*Larkin4/Sibling5*	210,000	343,000	591,000	1,013,000	1,651,000
Late Stuart	*R1C4/Sibling5*	10,000	19,000	39,000	85,000	180,000
Quesnel	*Ricker(Ei)*	63,000	137,000	319,000	882,000	1,836,000
Stellako	*Ricker(Ei)4/Sibling5*	51,000	87,000	157,000	288,000	476,000
Harrison	*TSA3/LLY4*	12,000	23,000	51,000	111,000	228,000
Raft	*LLY4/Sibling5*	3,000	5,000	9,000	17,000	30,000
Misc (N. Thomp. Tribs)	*R/S*	20	40	100	200	300
Misc (N. Thomp River)	*R/S*	200	300	800	2,000	3,000
Misc (Widgeon)	*R/S*	20	60	80	200	700
Late Total		50,000	93,000	188,000	387,000	796,000
Total excluding misc. stocks		50,000	93,000	188,000	386,000	793,000
Cultus	*PowerJuvPi*	0	10	20	60	100
Late Shuswap	*Ricker(Pi)4/Sibling5*	3,000	9,000	25,000	65,000	162,000
Portage	*Ricker(Ei)*	900	2,000	7,000	20,000	56,000
Weaver	*RickerCyc4/Sibling5*	15,000	30,000	64,000	140,000	306,000
Birkenhead	*Ricker(Pi)4/Sibling5*	31,000	52,000	92,000	161,000	269,000
Misc Harrison/Lillooet	*R/S*	70	200	300	900	3,000
TOTAL SOCKEYE SALMON		453,000	800,000	1,564,000	3,185,000	5,952,000
Total Sockeye excluding misc. stocks		445,000	789,000	1,518,000	3,112,000	5,832,000
TOTAL PINK SALMON	*MRJ*	3,247,000	4,389,000	6,135,000	8,575,000	11,591,000

Table B2. Spawning escapement plan for Fraser River sockeye and pink salmon in 2023. (Provided to the Panel by Fisheries and Oceans Canada and based on Fraser River Sockeye Spawning Initiative (FRSSI) guidelines with input from domestic consultations).

Management Unit		Pre-season Forecast Return				
		p10	p25	p50	p75	p90
	lower ref. pt. (w misc)	108,000	108,000	108,000	108,000	108,000
	upper ref. pt. (w misc)	135,000	135,000	135,000	135,000	135,000
Early Stuart	forecast	6,000	11,000	23,000	46,000	86,000
	TAM Rule (%)	0%	0%	0%	0%	0%
	Escapement Target	6,000	11,000	23,000	46,000	86,000
	MA	6,500	11,900	24,800	49,700	92,900
	Esc. Target + MA	12,500	22,900	47,800	95,700	178,900
	LAER	10%	10%	10%	10%	10%
	Available ER at Return	0%	0%	0%	0%	0%
	Max. Allowable ER	10%	10%	10%	10%	10%
	Max. Allowable Harvest	600	1,100	2,300	4,600	8,600
	2022 Performance					
	Projected S (after MA)	2,600	4,800	9,900	19,900	37,200
	BY Spawners	89	89	89	89	89
	Proj. S as % BY S	2921%	5393%	11124%	22360%	41798%
	cycle avg S	42,694	42,694	42,694	42,694	42,694
	Proj. S as % cycle S	6%	11%	23%	47%	87%

Management Unit		Pre-season Forecast Return				
		p10	p25	p50	p75	p90
Early Summer (w/o RNT)	*lower ref. pt. (w misc)*	131,900	131,900	131,900	131,900	131,900
	upper ref. pt. (w misc)	263,800	263,800	263,800	263,800	263,800
	forecast (incl. misc)	47,400	81,300	186,010	354,010	665,010
	TAM Rule (%)	0%	0%	29%	50%	50%
	Escapement Target	47,400	81,300	131,900	177,005	332,505
	MA	24,600	42,300	68,600	95,600	179,600
	Esc. Target + MA	72,000	123,600	200,500	272,605	512,105
	LAER	10%	10%	10%	10%	10%
	Available ER at Return	0%	0%	0%	23%	23%
	Max. Allowable ER	10%	10%	10%	23%	23%
	Max. Allowable Harvest	4,700	8,100	18,600	81,400	152,900
	2022 Performance					
	Projected S (after MA)	28,300	48,400	109,700	178,000	333,300
	BY Spawners	45,057	45,057	45,057	45,057	45,057
	Proj. S as % BY S	63%	107%	243%	395%	740%
	cycle avg S	144,327	144,327	144,327	144,327	144,327
	Proj. S as % cycle S	20%	34%	76%	123%	231%

Table B2, continued on next page

Table B2, continued.

Management Unit		Pre-season Forecast Return				
		p10	p25	p50	p75	p90
Summer (w. RNT & Har)	*lower ref. pt. (w misc)*	1,046,600	1,046,600	**1,046,600**	1,046,600	1,046,600
	upper ref. pt. (w misc)	2,093,200	2,093,200	**2,093,200**	2,093,200	2,093,200
	forecast	349,240	614,400	**1,166,980**	2,398,400	4,405,000
	TAM Rule (%)	0%	0%	**10%**	50%	50%
	Escapement Target	349,240	614,400	**1,046,600**	1,199,200	2,202,500
	MA	27,900	49,200	**83,700**	95,900	176,200
	Esc. Target + MA	377,140	663,600	**1,130,300**	1,295,100	2,378,700
	LAER	10%	10%	**10%**	10%	10%
	Available ER at Return	0%	0%	**3%**	46%	46%
	Max. Allowable ER	10%	10%	**10%**	46%	46%
	Max. Allowable Harvest	34,924	61,440	**116,698**	1,103,300	2,026,300
	2022 Performance					
	Projected S (after MA)	293,100	515,200	**977,200**	1,204,200	2,208,800
	BY Spawners	248,600	248,600	**248,600**	248,600	248,600
	Proj. S as % BY S	118%	207%	**393%**	484%	888%
	cycle avg S	667,166	667,166	**667,166**	667,166	667,166
	Proj. S as % cycle S	44%	77%	**146%**	180%	331%

Management Unit		Pre-season Forecast Return				
		p10	p25	p50	p75	p90
Late (w/o Har)	*lower ref. pt. (w misc)*	300,500	300,500	**300,500**	300,500	300,500
	upper ref. pt. (w misc)	601,000	601,000	**601,000**	601,000	601,000
	forecast	49,970	93,210	**188,320**	386,960	796,100
	TAM Rule (%)	0%	0%	**0%**	22%	50%
	Escapement Target	49,970	93,210	**188,320**	300,500	398,050
	MA	41,000	85,800	**195,900**	351,600	549,300
	Esc. Target + MA	90,970	179,010	**384,220**	652,100	947,350
	LAER	10%	10%	**10%**	10%	10%
	Available ER at Return	0%	0%	**0%**	0%	0%
	Max. Allowable ER	10%	10%	**10%**	10%	10%
	Max. Allowable Harvest	4,997	9,321	**18,832**	38,696	79,610
	2022 Performance					
	Projected S (after MA)	24,800	43,900	**83,100**	159,000	301,300
	BY Spawners	10,818	10,818	**10,818**	10,818	10,818
	Proj. S as % BY S	229%	406%	**768%**	1470%	2785%
	cycle avg S	445,337	445,337	**445,337**	445,337	445,337
	Proj. S as % cycle S	6%	10%	**19%**	36%	68%
Allowable Harvest (TF, US, CDN)		45,221	79,961	**156,430**	1,227,996	2,267,410
Total projected spawners		348,800	612,300	**1,179,900**	1,561,100	2,880,600

2023 Fraser Pink Escapement Plan

Run Size	Escapement Plan
Less than 7.059M	Exploitation rate increases linearly from 0% at run size =0 to 15% at run size = 7.059M
Between 7.059M-20M	Fixed Escapement. Escapement goal = 6,000,000
Greater than 20M	Exploitation Rate Cap = 70%

	2023 Pre-season Forecast Return				
	p10	p25	p50	p75	p90
forecast	3,247,000	4,389,000	**6,135,000**	8,575,000	11,591,000
escapement target	3,023,000	3,980,000	**5,335,000**	6,000,000	6,000,000
allowable ER	7%	9%	**13%**	30%	48%
Available Harvest (TF, US, CDN)	224,000	409,000	**800,000**	2,575,000	5,591,000

APPENDIX C: 2023 FRASER RIVER PANEL MANAGEMENT PLAN PRINCIPLES AND CONSTRAINTS (agreed July 14, 2023)

1. Fisheries and Oceans Canada (DFO) has provided the Panel with run-size forecasts for Fraser River sockeye and pink salmon. It is broadly understood that the sockeye run size forecasts are low due to the low number of sockeye that returned in 2019 and the impact of the Big Bar landslide in the same year. In addition, sockeye and pink run-size forecasts are very uncertain due to high variability in annual salmon productivity (e.g., the number of returning recruits per spawner, and the number of returning recruits per outmigrating fry), and observation error in the associated data. The median forecast for the total Fraser sockeye return is 1,564,000 fish, and there is a one in four chance that the actual number of returning sockeye will be at or below 800,000 fish and there is a one in four chance that the actual number of returning sockeye will be at or larger than 3,185,000 fish. The median forecasts for the four different management groups are 23,000 Early Stuart, 186,000 Early Summer-run, 1,167,000 Summer-run, and 188,000 Late-run sockeye. Of note, Chilko, Stellako and Quesnel sockeye represent 68% of the total Fraser sockeye return and 91% of the Summer-run return at the median forecast. Also of note is the large, expected contribution of 5-year-olds, constituting 49% of the total Fraser sockeye forecast, 99% for Early Stuart, 67% for Early Summer run, 39% for Summer run and 89% for Late run. The degree of uncertainty in Fraser sockeye forecasts is somewhat higher for 5-year-olds than 4-year-olds. The median forecast for Fraser River pink salmon is 6,135,000 fish, and there is a one in four chance that the actual number of returning pink salmon will be below 4,389,000, and a one in four chance that the return will be larger than 8,575,000. The median, or 50% probability level, forecasts for Fraser River sockeye and pink salmon were used for pre-season planning purposes. In addition, pre-season plans were developed for the 75% probability level forecasts for both sockeye and pink salmon, as well as early timing for pink salmon and higher northern diversion rates for sockeye. When sufficient information is available in-season, the Panel will adopt updated run size estimates of Fraser River sockeye and pink salmon, as appropriate.

2. The Panel's first priority is to meet sockeye spawning escapement goals by management group and the pink escapement objective. A coordinated approach to management has been developed that reflects both Parties sharing the burden of conservation. At the median forecast, no directed harvest of sockeye is planned; however, depending upon sockeye and coho constraints, both Canada and the United States anticipate harvesting the full pink salmon total allowable catch (TAC) if Fraser River pink salmon returns in 2023 correspond to the range of forecasts provided (p10 to p90).

3. TAC and international shares of the TAC are calculated according to the 2020 revised Annex IV, Chapter 4, of the Pacific Salmon Treaty, which limits the United States harvest (in Washington State) to 16.5% of the international TAC of Fraser River sockeye salmon and 25.7% of the international TAC of Fraser River pink salmon. For 2023, the Fraser River Panel agreed to pre-season Fraser River Aboriginal Fisheries Exemptions as determined by the process outlined in paragraph 3d for the purposes of computing Fraser River sockeye TAC by management group. The Panel will implement low abundance exploitation rates (LAER) for a management group when the allowable harvest for that group, according to Total Allowable Mortality rules as defined in Canada's escapement plan, has no identified TAC, in order to allow access to available TAC for other co-migrating Fraser River sockeye salmon management

groups. At the median forecasts, the LAERs are set at 10% for each sockeye management group. LAERs are not intended to create directed harvest opportunities in mixed stock areas, do not contribute to international TACs, and represent maximum allowable fishing-related impacts (including test fisheries and release mortalities). Calculated shares of the international TACs that fall below the LAER amount will contribute to the international share of the TAC.

4. Given pre-season assumptions about sockeye marine migration timing, recent late run delay behaviour, and an anticipated large proportion of en-route mortality due to predicted warm water temperatures, the Panel has agreed to use proportional Management Adjustment (pMA) factors for sockeye of 1.08 for Early Stuart, 0.56 for Early Summer, 0.23 for Summer, and 1.00 for Late Run sockeye.
5. At the median forecast, no directed harvest of sockeye is planned. However, some limited impacts on sockeye may occur in fisheries directed at harvestable surpluses of Fraser River pink salmon. It is understood that the overlapping of sockeye and pink salmon migrations may result in a small but acceptable rate of incidental harvest on one or more overlapping sockeye management groups that have little or no TAC. How this sockeye bycatch harvest occurs will be determined based on in-season information. Retention of sockeye bycatch at returns that are below levels which generate international TAC will be discussed in-season prior to approval. In the event that sockeye international TAC becomes available (e.g., if abundances approach p75), fisheries plans will be discussed by the Fraser River Panel, and harvests based on in-season information will be conducted respecting the conservation concerns for both nations on co-migrating stocks and species.
6. There is significant concern related to environmental conditions in 2023, as a result of the well below average snowpack and predicted air and water temperatures likely to be well above average, which may result in the adoption of more conservative management adjustments where appropriate to achieve the escapement objectives for the various sockeye management groups.

Regulations

i) If in-season conditions are consistent with pre-season expectations, low impact fisheries directed at pink salmon would be expected to commence in late-August in Panel Waters. The actual start dates and duration of fisheries will depend on in-season estimates of timing, abundance, diversion, and agreed management adjustments.

ii) At the median forecast, no directed harvest of sockeye is planned. However, some limited by-catch of sockeye as determined in-season may occur in fisheries directed at harvestable surpluses of Fraser River pink salmon.

iii) The Parties' conservation concerns for other species and stocks will be taken into account throughout the 2023 management season by minimizing by-catch of weak stocks of sockeye, Chinook, coho, and steelhead in fisheries directed at abundant stocks.

APPENDIX D: 2023 REGULATIONS

The Fraser River Panel approved regulations for the management of the Fraser River sockeye salmon fishery in Panel Area waters and submitted these to the Pacific Salmon Commission. The Commission approved the Fishery Regime and Regulations and submitted these to the respective national governments for approval on June 23, 2023.

Canadian Fraser River Panel Area

In accordance with Article VI, Paragraph 5 of the Pacific Salmon Treaty, the Commission recommends Canada adopt the following fishing regime developed by the Fraser River Panel, namely:

1. a) No person shall commercially fish for sockeye or pink salmon in Pacific Fishery Management Area 20-1, 3 and 4 with nets from the 25th day of June 2023, to the 23rd day of September 2023, both dates inclusive.

   b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 20-1, 3 and 4 from the 25th day of June 2023, to the 23rd day of September 2023, both dates inclusive.

2. a) No person shall commercially fish for sockeye or pink salmon in Pacific Fishery Management Areas 17 and 18 with nets from the 25th day of June 2023 to the 30th day of September 2023, both dates inclusive.

   b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 18-1, 4 and 11 from the 25th day of June 2023, to the 30th day of September 2023, both dates inclusive.

3. a) No person shall commercially fish for sockeye or pink salmon with nets in Pacific Fishery Management Area 29 from the 25th day of June 2023, to the 14th day of October 2023, both dates inclusive.

   b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 29 from the 25th day of June 2023, to the 14th day of October 2023, both dates inclusive.

4. The following Fraser River Panel Area waters are excluded:

   a) High Seas westerly of the Bonilla Point-Tatoosh Island Lighthouse Line.

   b) Pacific Fishery Management Area 19, Area 20-2 and 5 to 7 and Area 29-8.

   c) Commercial troll fishing in Pacific Fishery Management Area 17, Area 18-2, 3 and 5 to 10.

   d) The Fraser River and the tributary streams and lakes above the train bridge at Mission.

During the 2023 season, the Fraser River Panel will adopt orders establishing open fishing periods based on a 2023 management plan adopted by the Panel. This plan will be designed to achieve Pacific Salmon Treaty-mandated conservation objectives, international allocations of the catch, and domestic goals of the Parties.

United States Fraser River Panel Area

In accordance with Article VI, Paragraph 5 of the Pacific Salmon Treaty, the Commission recommends the United States adopt the following fishing regime developed by the Fraser River Panel, namely:

U.S. Tribal Fisheries:

1. No person shall commercially fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 4B, 5 and 6C with drift gillnets or purse seines from the 25th day of June 2023 to the 16th day of September 2023, both dates inclusive.

2. No person shall commercially fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 6, 6A, 7 and 7A with nets from the 25th day of June 2023, to the 23rd day of September 2023, both dates inclusive.

3. No person shall commercially fish for sockeye or pink salmon with nets in that portion of Puget Sound Salmon Management and Catch Reporting Area 7A lying westerly of a straight line drawn from the low water range marker in Boundary Bay on the International Boundary through the east tip of Point Roberts in the State of Washington to the East Point Light on Saturna Island in the Province of British Columbia from the 24th day of September 2023, to the 7th day of October 2023, both dates inclusive.

All-Citizen Fisheries:

1. No person shall commercially fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 4B, 5, and 6C with nets from the 25th day of June 2023, to the 16th day of September 2023, both dates inclusive.

2. No person shall commercially fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 6, 6A, 7 and 7A with nets from the 25th day of June 2023, to the 23rd day of September 2023, both dates inclusive.

3. No person shall commercially fish for sockeye or pink salmon with nets in that portion of Puget Sound Salmon Management and Catch Reporting Area 7A lying westerly of a straight line drawn from the low water range marker in Boundary Bay on the International Boundary through the east tip of Point Roberts in the State of Washington to the East Point Light on Saturna Island in the Province of British Columbia from the 24th day of September 2023, to the 7th day of October 2023, both dates inclusive.

The following Fraser River Panel Area waters and fisheries are excluded:

U.S. Tribal and All-Citizen Fisheries:

1. High Seas westerly of the Bonilla-Tatoosh Line.

2. Puget Sound Salmon Management and Catch Reporting Areas 6B, 6D, 7B, 7C, 7D and 7E.

During the 2023 season, the Fraser River Panel will adopt orders establishing open fishing periods based on a 2023 management plan adopted by the Panel. This plan will be designed to achieve Pacific Salmon Treaty-mandated conservation objectives, international allocations of the catch, and domestic goals of the Parties.

APPENDIX E: 2023 FRASER RIVER PANEL IN-SEASON ORDERS

To provide for adequate escapement of the various stocks of Fraser River sockeye salmon and for the prescribed allocation of catch: (a) internationally, between the United States and Canada and (b) domestically, among the commercial user groups in Canada and the United States, the Fraser River Panel formulated the following orders to regulate Panel Area fisheries.

August 18, 2023

United States

Treaty Tribal

Areas 4B, 5 and 6C

Open to drift gillnets from 12:00 p.m. (noon), Saturday, August 19, 2023 through 12:00 p.m. (noon) Tuesday, August 22, 2023.

Areas 6, 7 and 7A

Open to net fishing, from 5:00 a.m. through 9:00 p.m., Sunday, August 20, 2023.

August 22, 2023

Canada

Areas 29-3, 29-4 and 29-6

Open for Area H troll ITQ fishery not earlier than 00:01Thursday, August 24, 2023. Non-retention of sockeye. (Please refer to DFO Fishery Notice for further details).

United States

Treaty Tribal

Areas 4B, 5 and 6C

Extend for drift gillnets from 12:00 p.m. (noon), Tuesday, August 22, 2023 through 12:00 p.m. (noon) Friday, August 25, 2023. Sockeye must be released.

Areas 6, 7 and 7A

Open to net fishing, from 5:00 a.m. through 9:00 p.m., Wednesday, August 23, 2023, and 5 a.m. through 9 p.m., Frida, August 25, 2023. Sockeye must be released.

All Citizen

Areas 7 and 7A

Open to purse seine fishing from 5 a.m. to 9 p.m., Thursday, August 24, 2023 and 5 a.m. through 9 p.m., Friday, August 25, 2023. Sockeye must be released.

Areas 7 and 7A

Open for drift gillnet fishing from 8 a.m. to 11:59 p.m., Thursday, August 24, 2023. Sockeye must be released.

Area 7

Open for reef net fishing 5 a.m. through 9 p.m., Wednesday, August 23, 2023, 5 a.m. through 9 p.m., Thursday, August 24, 2023, and 5 a.m. through 9 p.m., Friday, August 25, 2023. Sockeye must be released.

August 25, 2023

Canada

Areas 29-3, 29-4 and 29-6

Open for Area H troll ITQ fishery not earlier than 00:01Thursday, August 24, 2023. Non-retention of sockeye. (Please refer to DFO Fishery Notice for further details).

United States

Treaty Tribal

Areas 4B, 5 and 6C

Extend for drift gillnets from 12:00 p.m. (noon), Friday, August 25, 2023 to 12:00 p.m. (noon) Wednesday, August 30, 2023. Sockeye must be released.

Areas 6, 7 and 7A

Open for net fishing, from 5:00 a.m., Saturday, August 26, 2023 through 9:00 a.m., Wednesday, August 30, 2023. Sockeye must be released.

All Citizen

Areas 7 and 7A

Open for purse seine fishing 5 a.m. through 9 p.m., Saturday, August 26, 2023; 5 a.m. through 9 p.m., Sunday, August 27, 2023; 5 a.m. through 9 p.m. Monday, August 28, 2023; and 5 a.m. through 9 p.m., Tuesday, August 29, 2023. Sockeye must be released.

Areas 7 and 7A

Open for drift gillnet fishing from 8 a.m. through 11:59 p.m., Saturday, August 26, 2023; 8 a.m. through 11:59 p.m., Sunday, August 27, 2023; 8 a.m. through 11:59 p.m., Monday August 28, 2023; and 8 a.m. through 11:59 p.m., Tuesday, August 29, 2023. Sockeye must be released.

Area 7

Open for reef net fishing from 5 a.m. through 9 p.m. Saturday, August 26, 2023; 5 a.m. through 9 p.m., Sunday, August 27, 2023; 5 a.m. through 9 p.m., Monday, August 28, 2023; and 5 a.m. through 9 p.m., Tuesday, August 29, 2023. Sockeye must be released.

August 29, 2023

Canada

Areas 29-3, 29-4 and 29-6

As previously announced, open for Area H troll ITQ fishery not earlier than 00:01Thursday, August 24, 2023. Non-retention of sockeye. (Please refer to DFO Fishery Notice for further details).

United States

Treaty Tribal

Areas 4B, 5, 6C

Extend for drift gillnets from 12 p.m. (noon), Wednesday, August 30, 2023 through 12 p.m. (noon) Friday, September 1, 2023. Sockeye must be released.

Areas 6, 7 and 7A

Extend for net fishing from 9 a.m., Wednesday, August 30, 2023 through 9 a.m. Saturday, September 2, 2023. Sockeye must be released.

All Citizen

Areas 7 and 7A

Open for purse seine fishing 5 a.m. through 9 p.m., Wednesday, August 30, 2023; 5 a.m. through 9 p.m., Thursday, August 31, 2023; 5 a.m. through 9 p.m. Friday, September 1, 2023. Sockeye must be released.

Areas 7 and 7A

Open for drift gillnet fishing from 8 a.m. through 11:59 p.m., Wednesday, August 30, 2023; 8 a.m. through 11:59 p.m., Thursday, August 31, 2023; 8 a.m. through 11:59 p.m., Friday, September 1, 2023. Sockeye must be released.

Area 7

Open for reef net fishing from 5 a.m. through 9 p.m. Wednesday, August 30, 2023; 5 a.m. through 9 p.m., Thursday, August 31, 2023; 5 a.m. through 9 p.m., Friday, September 1, 2023. Sockeye must be released.

September 1, 2023

Canada

Areas 29-3, 29-4 and 29-6

Open for Area H troll ITQ fishery not earlier than 00:01 Saturday, September 2, 2023. Non-retention of sockeye. (Please refer to DFO Fishery Notice for further details).

Areas 29-4, 29-6, 29-7, 29-8 and 29-10

Limited entry Area B seine ITQ fishery not earlier than 06:00 Sunday, September 3, 2023. Non-retention of sockeye. (Please refer to DFO Fishery Notice for further details)

United States

Treaty Tribal

Areas 4B, 5, and 6C

Extend for drift gillnet fishing from 12 p.m. (noon), Friday, September 1, 2023, through 12 p.m. Wednesday, September 6, 2023. Sockeye must be released.

Areas 6, 7 and 7A

Extend for net fishing from 9 a.m. Saturday, September 2, 2023, through 9 a.m. Wednesday, September 6, 2023. Sockeye must be released.

All Citizen

Areas 7 and 7A

Open for purse seine fishing 5 a.m. through 9 p.m., Saturday, September 2, 2023; 5 a.m. through 9 p.m., Sunday, September 3, 2023; 5 a.m. through 9 p.m. Monday, September 4, 2023; and 5 a.m. through 9 p.m., Tuesday, September 5, 2023. Sockeye must be released.

Areas 7 and 7A

Open for drift gillnet fishing from 8 a.m. through 11:59 p.m., Saturday, September 2, 2023; 8 a.m. through 11:59 p.m., Sunday, September 3, 2023; 8 a.m. through 11:59 p.m., Monday, September 4, 2023; and 8 a.m. through 11:59 p.m, Tuesday, September 5, 2023. Sockeye must be released.

Area 7

Open for reef net fishing from 5 a.m. through 9 p.m. Saturday, September 2, 2023; 5 a.m. through 9 p.m., Sunday, September 3, 2023; 5 a.m. through 9 p.m., Monday, September 4, 2023; and 5 a.m. through 9 p.m., Tuesday, September 5, 2023. Sockeye must be released.

September 5, 2023

Canada

Areas 29-4 and 29-6

As previously announced, open for Area H troll ITQ pink fishery not earlier than 00:01 Saturday, September 2, 2023. Non-retention of sockeye. (Please refer to DFO Fishery Notice for further details).

Areas 29-4, 29-6, 29-7, 29-9

Open for Area B seine ITQ pink fishery not earlier than 06:00 a.m. to 9:00 p.m. daily from Wednesday, September 6, 2023 to Friday, September 15, 2023. Non-retention of sockeye. (Please refer to DFO Fishery Notice for further details)

United States

Treaty Tribal

Areas 4B, 5, and 6C

Extend for drift gillnet fishing from 12 p.m. (noon), Wednesday, September 6, 2023, through 12 p.m. Saturday, September 9, 2023. Sockeye must be released.

Areas 6, 7 and 7A

Extend for net fishing from 9 a.m. Wednesday, September 6, 2023, through 9 a.m. Saturday, September 9, 2023. Sockeye must be released.

All Citizen

Areas 7 and 7A

Open for purse seine fishing 5 a.m. through 9 p.m., Wednesday, September 6, 2023; 5 a.m. through 9 p.m., Thursday, September 7, 2023; 5 a.m. through 9 p.m. Friday, September 8, 2023. Sockeye must be released.

Areas 7 and 7A

Open for drift gillnet fishing from 8 a.m. through 11:59 p.m., Wednesday, September 6, 2023; 8 a.m. through 11:59 p.m., Thursday, September 7, 2023; 8 a.m. through 11:59 p.m., Friday, September 8, 2023. Sockeye must be released.

Area 7

Open for reef net fishing from 5 a.m. through 9 p.m. Wednesday, September 6, 2023; 5 a.m. through 9 p.m., Thursday, September 7, 2023; 5 a.m. through 9 p.m., Friday, September 8, 2023. Sockeye must be released.

September 8, 2023

Canada

Areas 29-3, 29-4 and 29-6

Open for Area H troll ITQ pink fishery not earlier than 00:01 Saturday, September 2, 2023. Non-retention of sockeye. (Please refer to DFO Fishery Notice for further details).

Areas 29-3, 29-4, 29-6, 29-7, 29-9 and 29-10

Open for Area B seine ITQ pink fishery not earlier than 06:00 Sunday, September 3, 2023. Non-retention of sockeye. (Please refer to DFO Fishery Notice for further details)

United States

Treaty Tribal

Areas 4B, 5, and 6C

Relinquish regulatory control effective 11:59 p.m, Saturday, September 9, 2023.

Areas 6, 7 and 7A, excluding the Apex

Extend for net fishing from 9 a.m. Saturday, September 9, 2023, through 9 a.m. Wednesday, September 13, 2023. Sockeye must be released.

All Citizen

Areas 7 and 7A

Open for purse seine fishing 5:30 a.m. through 9 p.m., Saturday, September 9, 2023; 5:30 a.m. through 9 p.m., Sunday, September 10, 2023; 5:30 a.m. through 9 p.m. Monday, September 11, 2023; and 5:30 a.m. through 9 p.m., Tuesday, September 12, 2023. Sockeye must be released.

Areas 7 and 7A

Open for drift gillnet fishing from 8 a.m. through 11:59 p.m., Saturday, September 9, 2023; 8 a.m. through 11:59 p.m., Sunday, September 10, 2023; 8 a.m. through 11:59 p.m., Monday, September 1, 2023; and 8 a.m. through 9 p.m., Tuesday, September 12, 2023. Sockeye must be released.

Area 7

Open for reef net fishing from 5:30 a.m. through 9 p.m. Saturday, September 9, 2023; 5:30 a.m. through 9 p.m., Sunday, September 10, 2023; 5:30 a.m. through 9 p.m., Monday, September 11, 2023; and 5:30 a.m. through 9 p.m., Tuesday, September 12, 2023. Sockeye must be released.

September 12, 2023

Canada

Areas 29-3, 29-4 and 29-6

Open for Area H troll ITQ fishery not earlier than 00:01 Saturday, September 2, 2023. Non-retention of sockeye. (Please refer to DFO Fishery Notice for further details).

Areas 29-3, 29-4, 29-6, 29-7, 29-9 and 29-10

Open for Area B seine ITQ fishery not earlier than 06:00 Sunday, September 3, 2023. Non-retention of sockeye. (Please refer to DFO Fishery Notice for further details)

United States

Treaty Tribal

Areas 6, 7 and 7A, excluding the Apex

Extend for net fishing from 9 a.m through 11:59 p.m. Wednesday, September 13, 2023. Sockeye must be released.

Treaty Tribal and All Citizen

Areas 6, 7, and 7A, excluding the Apex

Relinquish regulatory control effective 11:59 p.m., Wednesday, September 13, 2023. The Apex is those waters north and west of the Area 7A “East Point Line,” defined as a line projected from the low water range marker in Boundary Bay on the International Boundary through the east tip of Point Roberts in the state of Washington to the East Point light on Saturna Island in the Province of British Columbia.

September 15, 2023

Canada

Areas 29-3, 29-4 and 29-6

Open for Area H troll ITQ fishery not earlier than 00:01 Saturday, September 2, 2023. Non-retention of sockeye. (Please refer to DFO Fishery Notice for further details).

Areas 29-3, 29-4, 29-6, 29-7, 29-9 and 29-10

Open for Area B seine ITQ fishery not earlier than 06:00 Sunday, September 3, 2023. Non-retention of sockeye. (Please refer to DFO Fishery Notice for further details)

Fraser River Panel control of Canadian Panel Areas was relinquished in accordance with the pre-season Regulations (Appendix D) as follows: Area 20 on September 23; Areas 17 and 18 on September 30; and Area 29 on October 14. Panel control of United States Panel Areas were relinquished as follows; Areas 4B, 5, 6, 6C on September 9 by in-season order, Areas 6, 7 and 7A, excluding the Apex, on September 13 by in-season order, and Area 7A, lying westerly of a straight line drawn from the low water range marker in Boundary Bay on the International Boundary through the east tip of Point Roberts in the State of Washington to the East Point Light on Saturna Island in the Province of British Columbia October 7, 2023, as per pre-season regulations.

APPENDIX F: PSC STAFF ACTIVITIES: STOCK MONITORING, IDENTIFICATION AND ASSESSMENT, AND MANAGEMENT ADJUSTMENTS

Stock Monitoring

Stock monitoring programs assess the abundance and migration timing of Fraser River sockeye and pink salmon at different points along their migration routes. The Stock Monitoring Group uses test fishery data from marine and freshwater areas, hydroacoustic abundance estimates collected in the Fraser River at Mission, B.C., and visual observations at Hells Gate. In addition to providing estimates of daily and cumulative passage in marine areas and at Mission, stock monitoring analyses provide projections of the number of fish migrating between marine areas and Mission, and estimates of diversion rates through Johnstone Strait. Stock composition information from the Stock Identification Group is used to apportion total estimates to sockeye stocks or stock groups and Fraser and non-Fraser origin pink salmon. This information is required for the development of fishing plans that aid in meeting spawning escapement and catch allocation objectives.

A. Test Fishing

Test fisheries provide much of the data used to assess the migration of Fraser River sockeye and pink salmon[22]. The catch-per-unit-effort (CPUE) data and collected biological samples from the test fisheries are used to generate abundance and stock composition estimates. Table 4 in the main body of the report summarizes the locations of Panel-approved test fisheries. Table F1 summarizes more detailed information about the nets and sampling strategies used in 2023.

Table F1. Sampling details for Panel-approved test fisheries conducted in 2023.

			2023						
Area	Name	Gear	Number of Vessels	Net Length (m)	Net Depth (meshes)	Mesh Size (mm)	Mesh Size (in)	Number of Sets	Set Duration (minutes)
Canadian Panel Areas									
20	Juan de Fuca Str.	Gillnet	1	549	90	130	5 1/8	2	300
20	Juan de Fuca Str.	Gillnet	1	549	90	127	5	2	300
20	Juan de Fuca Str.	Purse Seine	1	549	875	95	3 3/4	6	20
29-14	Fraser R. (Cottonwood)	Gillnet	1	220	Variable	Variable		2	20
29-16	Fraser R. (Whonnock)	Gillnet	1	320	Variable	Variable		2	20
29-16	Matsqui Fishwheel	Fishwheel[1]	1	n/a	n/a	n/a	n/a	n/a	n/a
United States Panel Areas									
7	San Juan Islands	Reefnet[2]	2	n/a	n/a	n/a		n/a	n/a
Canadian Non-Panel Areas									
12	Queen Charlotte Str. (Round Is.)	Gillnet	1	366	60	130	5 1/8	3	100
12	Johnstone Str. (Blinkhorn)	Purse Seine	1	397	575	95	3 3/4	6	20
	Fraser R. (Qualark)	Gillnet	1	30	Variable	Variable		6	5

[1] Fish caught in the fishwheel are sampled but are not harvested.
[2] Reefnet observations are made during periods of favorable tides. Fish are counted as they swim through the gear but are not harvested.

Information pertaining to the migration of Fraser River sockeye and pink salmon through marine areas is primarily obtained from the test fisheries in Area 20 (Juan de Fuca Strait) and Area 12 (upper Johnstone Strait) but may be augmented in some years by test fisheries in Area 13 (lower Johnstone Strait), U.S. Area 5 (Juan de Fuca Strait), and U.S. Area 7 (San Juan Islands). Test fisheries in Area 29 (lower Fraser River) are used to assess in-river species and stock composition

[22] Taylor, E. 2022. PSC test fisheries. In: Michielsens, C.G.J. and Martens, F.J. Editors. Overview of pre-season and in-season assessment methods for Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 49, 66-70 p.

for application to Mission passage estimates. When the Mission hydroacoustics program is not in operation, test fisheries in Area 29 provide passage estimates for sockeye salmon using CPUE models. The Qualark (Fraser River canyon) gillnet test fishery provides information on salmon species and stock composition for the Qualark hydroacoustics program.

In 2023, the Fraser River Panel aimed to minimize the financial costs of Panel-approved test fisheries as well as the impacts on successful escapement of sockeye salmon to spawning grounds within the Fraser River watershed. As 2023 was forecast to have a low return of Fraser River sockeye, the U.S. Area 5 gillnet, Area 29 Gulf troll, and the Area 13 purse seine test fisheries were not scheduled to operate. The U.S. Area 7 reefnet test fishery was scheduled for ten observations days.

The Whonnock gillnet test fishery began as planned on June 26 and was extended by four days to October 2 as delaying sockeye continued to migrate into the Fraser River. The Cottonwood gillnet test fishery began on July 26 and ended on September 14, one day earlier than scheduled as a result of mechanical issues onboard. The Qualark gillnet test fishery began on July 2, as planned, and was operated until October 4, which was 1 day later than planned. The Area 12 and Area 20 marine gillnet test fisheries operated as planned beginning on July 11 and July 10 and ending on July 28 and July 29, respectively. These dates were after the majority of the Early Stuart sockeye were expected to have migrated past these test fishery locations. The Area 12 purse seine operated as scheduled from July 20 to September 4. The Area 20 purse seine test fishery began as expected on July 21 and was operated until August 31, which was five days earlier than expected due to low sockeye and pink salmon catches.

The Area 7 reefnet observation test fishery operated for three days in August, prior to a U.S. commercial opening for pink salmon. The Matsqui fishwheel program, located on the left bank of the lower Fraser River between Crescent Island and Matsqui Island, was paid for by the PSC test fishing program for twelve days in August. This program was operated in-season to provide an additional method of estimating species composition in the near-shore portion of the river as well as provide an early signal of the pink salmon migration past the Mission hydroacoustics program. The 2023 test fishing season was also the third year of a four-year Southern Endowment Fund (SEF) project to evaluate a transition from the Cottonwood test fishing location to a new location at Brownsville Bar[23]. The project was fully funded by the SEF and aims to increase stock identification sample sizes while continuing to provide representative estimates of the true stock composition migrating into the lower Fraser River. Fish Passage Counters were present at Hells Gate seven days per week from July 9 to September 25 to confirm passage of sockeye upstream of the fishways.

The marine gillnet daily catches of sockeye in Area 20 were above the brood year catches but lower than the cycle-year average throughout the season. The Area 12 marine gillnet daily catches of sockeye were similar to the brood year and were consistently lower than the cycle-year average throughout the season. Marine purse seine daily catches of sockeye in Area 20 were higher than the brood year but lower than the cycle-year average throughout the season with the exception of the period of August 11 to 14 when sockeye catch estimates were higher than both the brood year and the cycle-year average. Sockeye catches in the Area 12 purse seine were higher than the brood year and on average similar to the cycle-year average throughout the season. Sockeye catches were highly variable in Area 12 with daily catches exceeding 9,000 on August 12.

Pink salmon catches in the Area 12 and 20 purse seine test fisheries were historically high and well above the brood year and historical average. Pink salmon catches in Area 20 peaked on August 12 and August 20 with daily catches of 52,160 and 69,700, respectively, exceeding the previous

[23] Sutherland, T., M Baltzell, A. Keizer, A. Fisher. 2023. Lower Fraser River Gillnet Test Fishery Site Evaluation 2023 Post-season Report. Pacific Salmon Commission. 8Z_02ho9xJB6M2xyPiOitCYfHRwC_iyVuCHX59a81-g (airtableusercontent.com)

daily pink catch record of 17,653. Pink salmon catches in Area 12 peaked on August 9, 12, and 27 with daily catches of 88,365, 92,412, and 60,103 and becoming the 2nd, 1st, and 6th largest catch days on record.

Sockeye catches at Cottonwood and Whonnock were both higher than the brood year but lower than the cycle-year average throughout the entire season with the exception of the third week of August when catches were higher than the cycle-year average. Pink salmon catches at Whonnock and Cottonwood were higher than 2021, lower than 2019, and similar to the historical average. Sockeye catches in the Qualark test fishery were higher than the brood year throughout the season. Pink salmon catches at the Qualark test fishery were similar to 2021 and 2017, and higher than 2019.

Only sockeye that were required for scientific samples were retained in the test fisheries. A small number of pink salmon were retained in excess of those required for scientific samples in the Area 12 purse seine test fishery. Fish sales were unable to offset program costs and the 2023 program deficit of $786,100 was paid for by the Test Fish Revolving Fund.

Following the conclusion of the four-year SEF project to evaluate the transition from a multistrand nylon gillnet to an Alaska twist gillnet in Area 12, an Alaska Twist gillnet was built and operated in Area 20 during the 2023 season. This net was operated concurrently with the traditional multistrand nylon gillnet for a total of 16 days.

B. Mission Hydroacoustics

Pacific Salmon Commission Secretariat staff operate a seasonal hydroacoustics monitoring program on the Fraser River, 2km upstream of the Mission Railway Bridge and approximately 80km upstream of the river mouth. The purpose of the site is to provide accurate and timely estimates of sockeye and pink salmon passage through the lower Fraser River.

A sampling system using both split-beam and imaging sonars has been used at the Mission hydroacoustics site to quantify upstream salmon passage since 2011.[24] In 2023, daily upstream salmon escapement was estimated using a side-looking split-beam sonar (S1) and Adaptive Resolution Imaging Sonar (ARIS; A1) on the left bank of the river, a down-looking split-beam sonar (M) and ARIS (M2) deployed from a mobile vessel in the offshore portion of the river, and a side-looking ARIS (A2; Figure F1) on the right bank of the river. As of 2023, the mobile ARIS was adopted as the primary method for offshore salmon enumeration and was used to validate offshore fish behavioral statistics (i.e., swimming direction, milling, holding).[25]

Sampling schemes and methodology for each system, apart from M2, are detailed in Chapters B11-B14 of the PSC Technical Report No. 49.[26] The M2 system consists of a down-looking 15°x30° elliptical imaging sonar, manufactured by Soundmetrics Corporation. Similar to the mobile split-beam, the M2 system was deployed from a transecting, mobile vessel using a custom tow body.[3] In contrast to the mobile split-beam, the mobile ARIS can directly provide information on the direction of target travel. Thus, a mobile ARIS-derived downstream ratio, rather than a downstream ratio from the left bank split-beam, was applied to offshore density data to estimate offshore passage. As processing of mobile ARIS data is time-intensive, an 8-hour sampling scheme was used to provide timely offshore passage estimates of salmon-sized targets. Using this sampling scheme, only data

[24] Lagasse, C.R. and Xie, Y. 2022. Daily Estimation of Salmon Passage at the Mission Site. In: Michielsens, C.G.J. and Martens, F.J. Editors. Overview of pre-season and in-season assessment methods for Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 49, 116-120 p.
[25] Bartel Sawatzky, M. and Hornsby, R.L. 2022. Improved estimation of offshore fish passage at Mission by replacing split-beam system with imaging sonar: A final project to the Southern Boundary Restoration and Enhancement Fund. Pacific Salmon Commission, March 2022.
[26] Michielsens, C.G.J. and Martens, F.J. Editors. Overview of pre-season and in-season assessment methods for Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 49, 217 p.

from every third hour (e.g., 5 AM, 8AM, 11AM, etc.) was processed unless there were data gaps in the offshore (e.g., due to Food, Social, and Ceremonial [FSC] drift net fishing at Mission). For these dates, either adjacent hours or a full day of available data were processed depending on the scope of the data gap.

Data on target counts and density, direction of travel, speed, and size distributions were collected by the Mission hydroacoustics sonars. All five systems were deployed on July 1, with M being deployed until September 24, A2 until September 29, and left bank (A1, S1) and M2 systems until October 2. To calculate daily passage on the right bank between September 29 and October 2, the mean ratio of A2 / A1+S1+M2 passage for the three days prior, September 26-28, was applied to A1+S1+M2 passage for each date missing A2 sampling.

Salmon passage estimates from each system (A1, S1, M, M2, A2) were spatially stratified and combined to obtain daily total salmon escapement. The primary system combination for official estimates was A1+S1+M2+A2 (August 4 – October 2). Alternative system combinations used for official estimates were: S1+M+A2 (July 1 – July 18), and S1+M2+A2 (July 19 – August 3). Early in the season, a 3-system estimate using S1 to sample the full left-bank region (0-40m) was adopted to mitigate issues with small, downstream-moving resident fish and low salmon abundance. On July 19, M2 supplanted M as the primary method for offshore salmon estimation, as salmon behaviour observed by the M2 system (high offshore passage, low in the water column) suggested a potential negative bias by the M system. Regardless of the system configuration used to enumerate salmon passage, data from the shore-based systems were preferentially used where the GPS identified vessel-based and shore-based systems as overlapping. Estimates derived from the vessel-based systems are less precise than that from the shore-based systems, as the sampling intensity is lower and vulnerability to avoidance behaviour can contribute to a negative bias.[27] On the left bank of the river, A1 was used to estimate salmon passage up to a 40-metre range, and S1 was used for the 40 to 50-metre range. Over the 2023 monitoring period (July 1 to October 2), A1 and S1 left bank systems saw 74.3%, the right bank A2 system saw 8.6%, and offshore systems observed 17.1% of total upstream salmon passage at Mission.

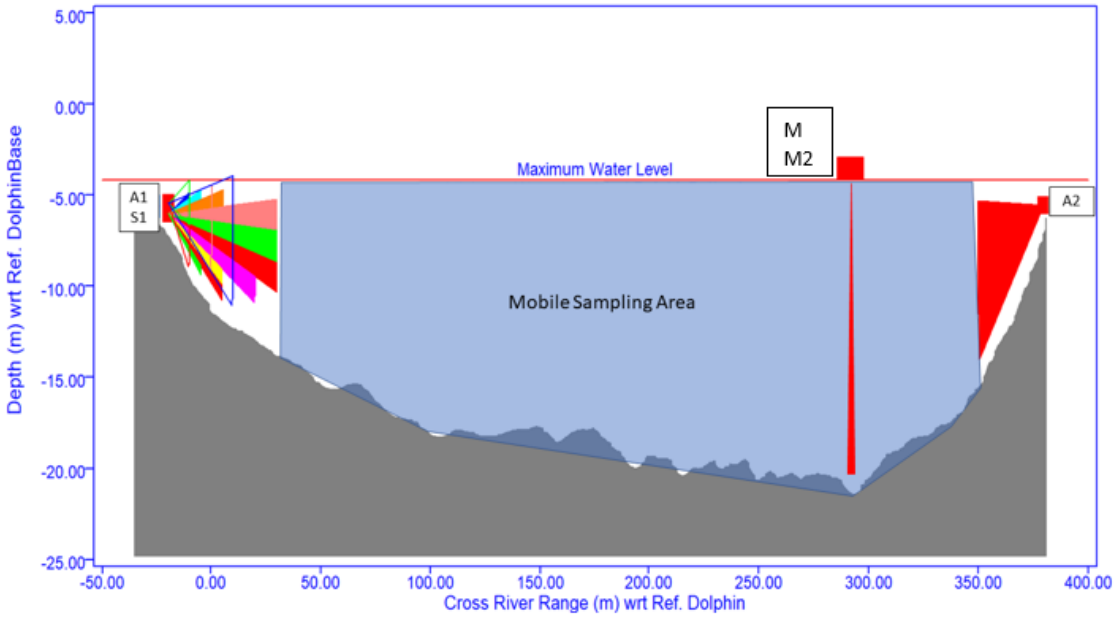

Figure F 1. Cross-river view of the sampling geometry of the sonar systems operated at the Mission hydroacoustics site. The five systems shown are the left bank split-beam (S1), the left bank ARIS

[27] Xie, Y., C.G.J. Michielsens, A.P. Gray, F.J. Martens, and J.L. Boffey. 2008. Observations of avoidance reactions of migrating salmon to a mobile survey vessel in a riverine environment. Can. J. Fish. Aqua. Sci. 65 2178-2190.

(A1), the mobile split-beam (M), the mobile ARIS (M2), and the right bank ARIS (A2). The beam geometries of A1 are represented by hollow triangles and overlap with the S1 beam geometries, which are represented by coloured triangles. The blue-filled offshore area represents the cross-river region sampled by M2 (and M). The beam coverage of A2 and the river bottom are represented by the red-filled triangle and the gray-filled area, respectively. Note that the cross-river range scale on the x-axis is compressed relative to the vertical depth scale on the y-axis.

In accordance with the signed Protocol between the PSC, Fisheries and Oceans Canada, and Sumas First Nation, the site's transecting vessel was docked during FSC drift net fisheries at Mission. Mission data imputations,[28] linear or non-linear interpolations for data gaps, were performed to account for any missing data and altered fish behaviour observed during the 10 drift net openings during the 2023 season.

Species Composition

Lower river hydroacoustics estimates of total fish passage are first apportioned into salmonid and non-salmonid (i.e. resident fish) using length-based mixture models[29]. While multiple Pacific salmon species co-migrate up the Fraser River, the main focus of assessments is on enumerating sockeye and pink salmon. Species-specific salmon estimates are derived using information from multiple sources, including: species proportions or catch-per-unit effort (CPUE) from the Whonnock and Albion gill net test fisheries, modelled forecasts of daily Chinook salmon abundance, and length-based model estimates using ARIS fork length frequency distributions[30,31]. When sockeye salmon are the dominant species and the Mission hydroacoustic program is operational, sockeye abundance is primarily estimated by subtracting estimates of Chinook and pink salmon from the total hydroacoustic estimate. For species such as pink salmon, which concentrate in near shore areas, a stratified approach is applied using a combination of methods. Where available, comparisons are also made in other upriver assessment programs, such as fish wheels.

Sockeye and pink salmon were the main species of interest in 2023. Sockeye were the dominant species from July 1 – August 23, and it was estimated by subtracting estimates of other salmon from the total hydroacoustic estimate. During this period, Chinook salmon abundance was estimated using a variety of methods: the median daily forecast abundance, historic average, the daily p75 forecast abundance and the Albion catch-per-unit-effort (CPUE). For pink salmon abundance during this period, it was estimated using the three-day average CPUE data from the Brownsville Bar test fishery (August 4 – 20) and a stratified method combining Whonnock pink salmon proportions from offshore estimates and Matsqui fish wheel data for near shore estimates (August 21-23).

During periods when the Mission hydroacoustic site is not operational and/or pink salmon are the dominant species, sockeye abundance is primarily estimated using Whonnock test fishery CPUE data, and pink salmon are estimated by subtracting sockeye and other salmon species (Chinook, chum, coho) from the total hydroacoustic estimate. This method relies on an historical time-varying

[28] Bzonek, P., Hornsby, R.L, Xie, Y., Nelitz, J., Bartel Sawatzky, M., Martens, F., and Michielsens, C.G.J. 2022. Mission Data Imputation During Fishery Openings: A report to the Southern Boundary Restoration and Enhancement Fund. Pacific Salmon Commission, March 2022.
[29] Michielsens, C.G.J. 2022. Species Information: Overview. In: Michielsens, C.G.J. and Martens, F.J. Editors. Overview of pre-season and in-season assessment methods for Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 49, p. 145-150.
[30] Grant, S., M. Townsend, B. White, and M. Lapointe. 2014. Fraser River Pink Salmon (*Oncorhynchus gorbuscha*) Data Review: Inputs for Biological Status and Escapement Goals. Report prepared for Pacific Salmon Commission. May, 2014.
[31] Conrad, B., A. Dufault, M. Hawkshaw, A. Huang, E. Jenkins, C. Lagasse, M. Lapointe, M. Litz, F. Martens, C. Michielsens, J. Scroggie, M. Staley, T. Whitehouse, C. Wor, and Y. Xie. 2019. Hydroacoustics Review Technical Summary. Pacific Salmon Comm. Tech. Rep. No. 41: 369 p.

expansion line for sockeye salmon. In 2023, sockeye abundance was estimated using three-day average Whonnock CPUE data from August 24 – October 2.

Stock Identification

PSC staff conduct sampling programs designed to identify stock proportions of Fraser River sockeye and pink salmon in commercial, test, First Nations and recreational catches[32]. Stock identification data are used to account for Fraser sockeye and pink salmon wherever they are caught, and to apportion the daily estimates of sockeye escapement past Mission into discrete stock groups. Stock identification methods for sockeye and pink salmon in 2023 used DNA analyses from fish caught in marine and in-river fisheries[33]. Additionally, scale pattern analysis was used to supplement DNA information for sockeye[34]. For sockeye salmon, a multinomial extrapolation procedure was used for predicting stock composition estimates in catches that had not yet occurred or had not yet been analyzed. For pink salmon, projections were made using a Bayesian approach that relied on data from previous years and 2023 DNA data.

A. Sockeye Salmon

Both DNA and scale pattern analyses involve comparing the attributes of individuals in mixture samples (e.g., from mixed-stock fisheries) to the attributes of pure samples obtained from the spawning grounds of each of the named stocks (i.e., "standards" or "baselines")[35]. Samples from test fishery catches were analyzed daily, beginning in early July and continuing to early October. PSC staff sampled sockeye from test fishery catches (Bellingham in Washington; Port Renfrew and locations within the lower Fraser River, B.C.) and commercial fishery catches (Bellingham in Washington, Surrey and Richmond in B.C.). Additionally, DFO provided samples from a commercial fishery near Campbell River, test fisheries in Johnstone Strait and in-river test fisheries at Albion and Qualark. Alaska's Department of Fish and Game collected samples for the PSC from District 104 purse seine landings in Ketchikan and Petersburg, and Langara Fishing Adventures provided samples from recreational catches near Haida Gwaii. DFO and First Nations personnel obtained samples from Fraser River First Nations catches when available.

Catches in District 104 totaled 156,000 sockeye. Extracted DNA of fish with at least 75% probability of being Fraser sockeye (as determined by examination of Single Nucleotide Polymorphisms[36] by the US National Oceanic and Atmospheric Administration laboratory in Auke Bay, Alaska) was obtained and analyzed with methods consistent with other DNA results reported here and to the Fraser Panel. The preliminary catch of Fraser River sockeye in Alaska was estimated to be 7,775.

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[32] Phung, A. and Brkic, D. 2022. Sampling Protocol. In: Michielsens, C.G.J. and Martens, F.J. Editors. Overview of pre-season and in-season assessment methods for Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 49, 89-93 p.

[33] Samarasin, P. and Latham, S. 2022. DNA-based Stock ID Method. In: Michielsens, C.G.J. and Martens, F.J. Editors. Overview of pre-season and in-season assessment methods for Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 49, 109-115 p.

[34] Gable, J. and S. Cox-Rogers. 1993. Stock identification of Fraser River sockeye salmon: methodology and management application. PSC Tech. Rep. No. 5.

[35] Samarasin, P. and Latham, S. 2022. Stock Composition Estimates Based on Scale Pattern Analyses. In: Michielsens, C.G.J. and Martens, F.J. Editors. Overview of pre-season and in-season assessment methods for Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 49, 103-108 p.

[36] Guthrie III, C.M., Nguyen, H. and J.R. Guyon. Northern Boundary Area Sockeye Salmon Genetic Stock Identification For Year 2015 District 101 Gillnet and District 104 Purse Seine Fisheries. A project report to Northern boundary restoration and enhancement fund. Pacific Salmon Commission, Vancouver, British Columbia. April 10, 2017.

During each management season, DNA estimates, scale measurements (including age), sex, and length information are compiled at the individual level to assist interpretations and assess possible sampling issues. Table F2 summarizes the age composition (based on scale readings by Staff) of sockeye catches compared to the pre-season forecast. Discrepancies between the forecast and in-season estimates of age composition could in part be due to low sample sizes. Low proportions of age-four fish were forecast for Early Stuart, Early Summer and Late run management groups. The age-four forecast for returning Early Stuart sockeye was similar to the observed proportion of age-four fish in fishery samples collected in 2023. Within the Early Summer run group, most stocks except for Nadina and Nahatlatch had a higher proportion of age-four fish observed than forecast. Within the Summer run group, the observed Late Stuart/Stellako age-four proportion was less than the forecast whereas a higher-than-forecast age-4 proportion was observed for Quesnel sockeye. Within the Late run group, a higher age-four proportion was observed for all stocks than was forecast.

Table F 2: Summary of the 2023 forecast and in-season age composition estimates of sockeye sampled from fisheries. Scale-based ages of individuals with probabilities of origin greater than 67% (determined via genetic stock identification) to a stock aggregate are included here.

Sockeye stock/timing group	2023 Fraser Sockeye Forecasts			2023 In-season	
	Median Age-4 Forecast	Total Median Forecast	% Age-4	Sample size	% Age-4
Early Stuart	**200**	**23,000**	**1%**	**53**	**6% ***
Chilliwack	1,400	2,000	70%	68	87%
Pitt	2,000	31,000	6%	125	43%
Nadina	32,000	76,000	42%	691	17%
Bowron	30	2,000	2%	20	60%
Nahatlatch	1,400	2,000	70%	36	56%
Gates	11,200	12,000	93%	179	95%
Taseko	0	10	0%	12	83%
North Barriere	800	2,000	40%	13	69%
Early S. Thompson	12,000	59,000	20%	132	83%
Early Summer	**60,830**	**186,010**	**33%**	**1,276**	**44%**
Harrison	14,000	51,000	27%	76	94%
Widgeon	50	80	62%	1	94%
Late Stuart/Stellako	138,000	196,000	70%	711	52%
Chilko	486,000	591,000	82%	1,788	78%
Quesnel	73,000	319,000	23%	266	36%
Raft/North Thompson	6,180	9,900	62%	78	77%
Summer	**717,230**	**1,166,980**	**61%**	**2,920**	**68%**
Birkenhead	6,000	92,000	7%	456	61%
Misc. Lillooet-Harrison	20	300	7%	1	100%
Late Shuswap/Portage	8,000	32,000	25%	100	62%
Weaver	6000	64,000	9%	398	40%
Cultus	0	20	NA	0	NA
Late	**20,020**	**188,320**	**11%**	**955**	**52%**
Total	**798,000**	**1,564,000**	**51%**	**5,204**	**59%**

* Early Stuart in-season age-4 proportions are likely biased high as the sampled individuals tended to be later than expected and had less certain genetic results. Preliminary spawning ground estimates suggest only 1- 3% age-4 sockeye.

B. Pink Salmon

Three main stock groups are identified in catches of pink salmon – Fraser River, Canada South Coast (excluding Fraser), and Washington. Estimation is made possible through the analysis of baseline genetic information that has been collected from numerous stocks from these three regions[37]. The composition of the pink salmon baseline was similar to other recent years. During the 2023 in-season management period, tissue samples from approximately 400 pink salmon were collected per week from test fisheries. The DNA analyses were conducted similarly to those in recent years, with genotype data from 16 microsatellite loci being compared to allelic frequencies in 46 baseline stocks[6] using the program ONCOR[38]. Stock composition estimates derived from these analyses were used primarily for assessing catch, migration route (diversion rate), and abundance of Fraser River pink salmon. DNA results were obtained for Canadian statistical Areas 12 and 20 from test fishing catches (late July to late August or early September), and for U.S. Areas 7 and 7A from commercial fishery samples (late August to early September). One sample from August 15 was obtained from Area 13. A Bayesian model using historical stock proportions as a prior and in-season sample stock proportions as the data was used to update the posterior distribution for the proportion of Fraser River pink salmon in each statistical area, and these estimates were applied to catches. This approach has served to provide estimates for dates without samples and ameliorate the high variability inherent in the ONCOR estimates of pink salmon stock composition for specific dates, improving predictions for fishery planning. In the past, late dates and poor sample availability for especially Area 7A fisheries led to difficulties in applying this method. A retrospective analysis was conducted in 2023 to assess the accuracy of using data from other statistical areas compared to using historical model fits from the same statistical area to predict stock proportions.

The results of the retrospective analysis suggested that Area 7 and 7A could be borrowed interchangeably if a direct sample wasn't available. If only Area 20 samples were available, however, relying on historical estimates from the same area performed better than inter-area regressions. If Area 13 samples were missing, Area 12 data could be usefully incorporated to improve the modeled Area 13 estimates. Further work could continue to explore how to optimize information gain when borrowing from other areas, e.g., how should direct-area samples be weighted relative to data borrowed from other areas.

For 2023, the highest in-season sample estimates of Fraser pink salmon proportions were 55% (September 4) and 54% (August 24) in Area 12 and Area 20, respectively. Proportions of Fraser stocks in Area 12 samples were relatively low in August of 2023 compared to most years since 2009 (see Figure F2). In contrast, Washington proportions in Area 12 and Area 20 samples were relatively high in August of 2023 compared to other years (except for one mid-August sample in both areas).

[37] Beacham, T.D., McIntosh, B., MacConnachie, C., Spilsted, B., and B. White. 2012. Population structure of pink salmon (*Oncorhynchus gorbuscha*) in British Columbia and Washington, determined with microsatellites. Fish. Bull. 110:242–256

[38] Kalinowski, S.T., K.R. Manlove, and M.L. Taper. 2008. ONCOR: a computer program for genetic stock identification, v2.0. Montana State University, Bozeman. Available: http://www.montana.edu/kalinowski/Software/ONCOR.htm.

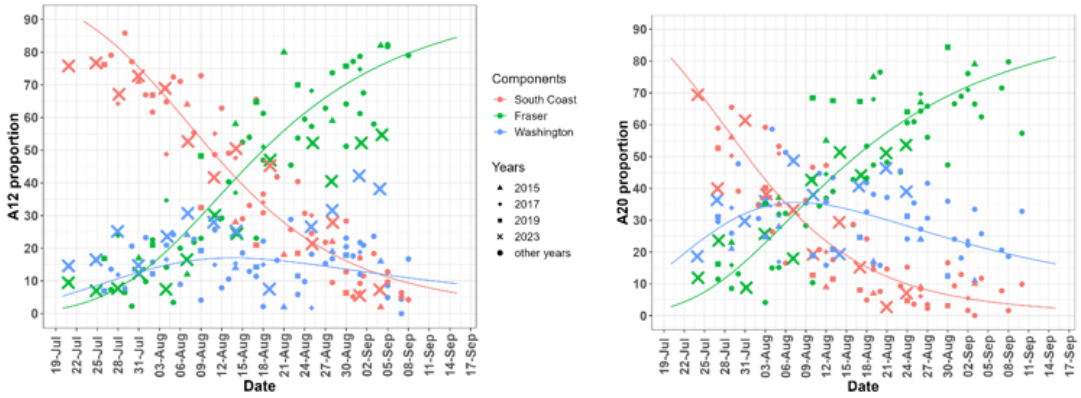

Figure F 2: Observed proportions of Canada South Coast and Fraser River pink salmon for Area 12 (left) and Area 20 (right). Data are from 2009-2023 but the curves represent Bayesian model fits based on all years excluding 2023.

Stock Assessment

Assessment of Fraser River sockeye salmon abundance by stock group is primarily based on catch, effort, escapement, and stock composition data. Test fishery catch-per-unit-effort (CPUE) data is converted into daily abundances using catchability estimates derived from a hierarchical analysis of historical data. As the season progresses, the catchability coefficients are updated based on observed values for non-delaying stock groups by comparing reconstructed marine abundances derived from Mission hydroacoustic passage estimates and marine catches[39] to CPUE-based abundances. The reconstructed marine abundances derived from in-river hydroacoustic, and marine test fishery data are analysed using Bayesian stock assessment models[40, 41,42,43]. These models compare the reconstructed daily migration pattern to ideal run-timing curves, assuming the run is normally distributed. By assuming the run follows this idealized pattern, the run size can be estimated by doubling the abundance up to the observed 50% migration date (i.e., the date 50% of the run has migrated past the reference location, which corresponds to the peak of the normal distribution). Prior to the peak of the run, run size and timing estimates are confounded and there is considerable uncertainty as to whether the run is earlier and smaller than forecast, or later and larger than forecast. Once more than 50% of the run has been observed at the Mission hydroacoustics site, a hybrid approach is applied whereby the run size can be estimated by adding the Bayesian estimate of the tail of the normal distribution to the cumulative observed reconstructed abundances.

Bayesian methodology is used to quantify the uncertainty in run size and timing estimates. A Bayesian cumulative normal model is informed by additional forecasted and historical information, including (1) pre-season forecasts of run size based on historic stock-recruit data, (2) pre-season forecasts of timing, (3) expected duration of the run, (4) average historical expansion line (inverse catchability) estimates, and (5) pre-season forecasts of diversion rate, to reduce the uncertainty and

[39]Michielsens, C.G.J. 2023. Marine Catchability Estimates. In: Michielsens, C.G.J. and Martens, F.J. Editors. Overview of pre-season and in-season assessment methods for Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 49, p. 82-88.
[40] Pacific Salmon Commission. 1995. Pacific Salmon Commission run-size estimation procedures: An analysis of the 1994 shortfall in escapement of Late-run Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 6: 179 p.
[41] Pacific Salmon Commission. 1998. Report of the Fraser River Panel to the Pacific Salmon Commission on the 1995 Fraser River sockeye and pink salmon fishing season. Vancouver, B.C., 64 p.
[42]Michielsens, C.G.J. and J.D. Cave. 2018. In-season assessment and management of salmon stocks using a Bayesian time-density model. CJFAS. https://doi.org/10.1139/cjfas-2018-0213.
[43]Michielsens, C.G.J. 2023. In-season time-density model. In: Michielsens, C.G.J. and Martens, F.J. Editors. Overview of pre-season and in-season assessment methods for Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 49, p. 160-166.

keep the run size estimates within realistic bounds. This prior information is incorporated within the Bayesian model using prior probability distributions (priors). These priors indicate a range of values that are assumed plausible for the various model parameters and, depending on the shape of the prior probability distribution, indicate which parameter values are assumed more likely than others. Theoretically, the Bayesian version of the cumulative normal model should provide more stable estimates since it relies on both in-season observations as well as historical data. Retrospective analyses have confirmed that incorporating prior knowledge is especially informative prior to, and immediately after, the 50% migration date. Once more than 50% of the run has been observed at the Mission hydroacoustics site, the run size can be estimated by adding the Bayesian estimate of the tail of the normal distribution to the accounted run-to-date.

For Late-run stocks, which delay and redistribute prior to migration into the Fraser River, it is not possible to replace the daily estimates from test fishing with daily hydroacoustic-based estimates. Thus, only marine CPUE can be used in the Bayesian cumulative normal model to assess run size, resulting in larger uncertainty in run size compared to stocks that also rely on marine reconstructed data. Test fishery CPUE data for pink salmon is converted into daily abundance estimates using catchability coefficients derived using an analysis of historical data (Area 12 purse seine catchability: 2.9×10^{-3}, Area 20 purse seine catchability: 9.5×10^{-4}). Due to the long delay and inconsistent offset between marine and Mission daily abundances, the daily pink salmon catchability cannot be updated using in-season Mission information. As a result, pink run size and timing estimates from the Bayesian cumulative normal model are often highly uncertain. Therefore, a variety of alternative approaches were also used in 2023 to inform in-season pink salmon stock assessments. These methods included regressions of run size against (1) cumulative CPUE-to-date, (2) average short-range (3-7 days) CPUE prior to the peak of the run, and (3) cumulative Mission passage-to-date. In addition, estimates of seaward abundance based on historical observations were used to expand current observations into total run size estimates. Finally, a timing-based approach was used which doubled the CPUE prior to an assumed 50% date.

Figures F3 a, b, c, and d provide an overview of the run size estimates from the different stock assessment models and the accounted run size at various dates during the season (median estimate and 80% probability intervals, if calculated). These estimates can be compared against the Panel adopted in-season run size estimates used for management purposes and against the final in-season estimates of the accounted run-to-date. In 2023, pre-season forecasts underestimated the run size for all sockeye management groups except for the Summer run. The pre-season forecast for Fraser River pink salmon also underestimated the run size. Marine timing of Early Stuart, Early Summer, Summer, and Late-run groups were 5-days, 10-days, 4-days, and 6-days earlier than expected pre-season, respectively. In addition, the marine timing of Fraser River pink salmon was 8-days earlier than expected pre-season.

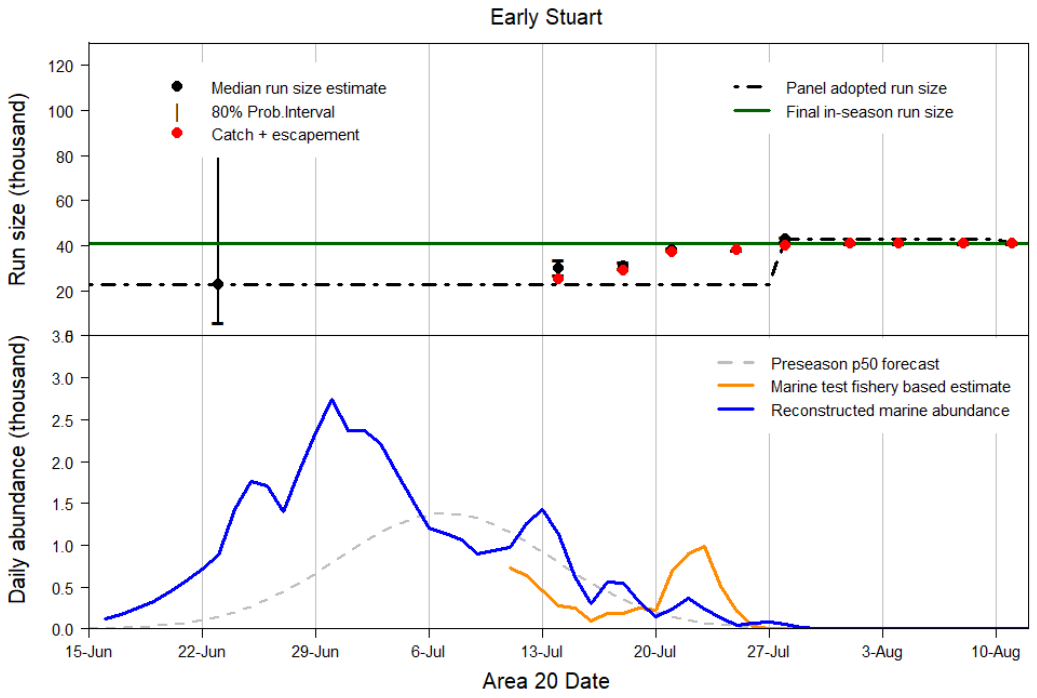

Figure F 3a: Daily reconstructed abundance estimates for Early Stuart and corresponding run size estimates at different times during the season.

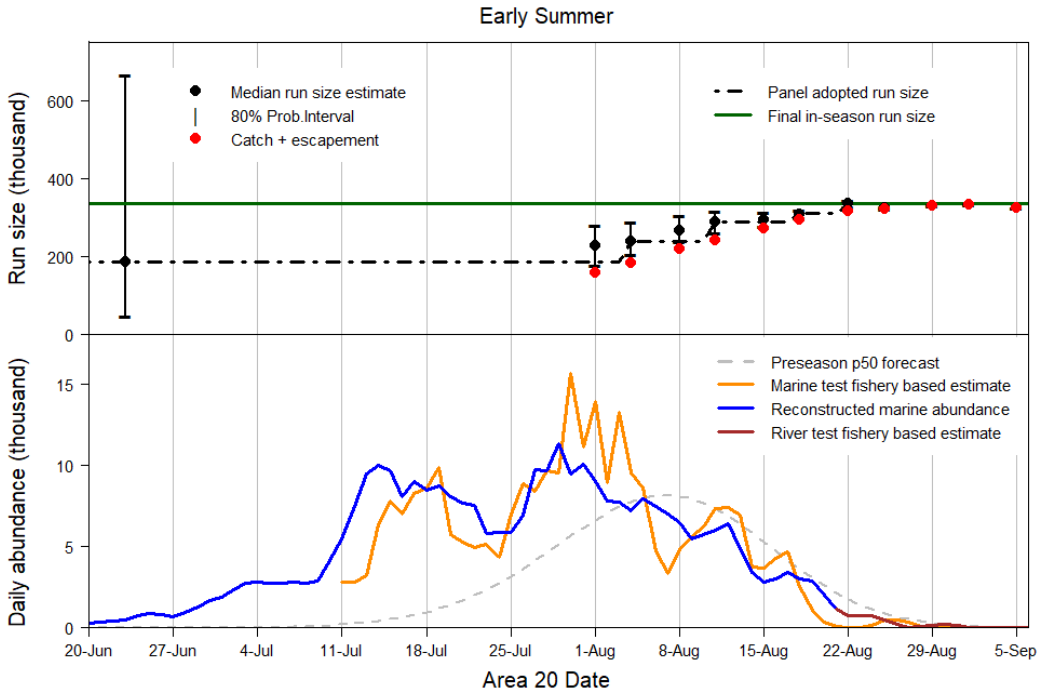

Figure F 3b: Daily reconstructed abundance estimates for Early Summer-run salmon and corresponding run size estimates at different times during the season.

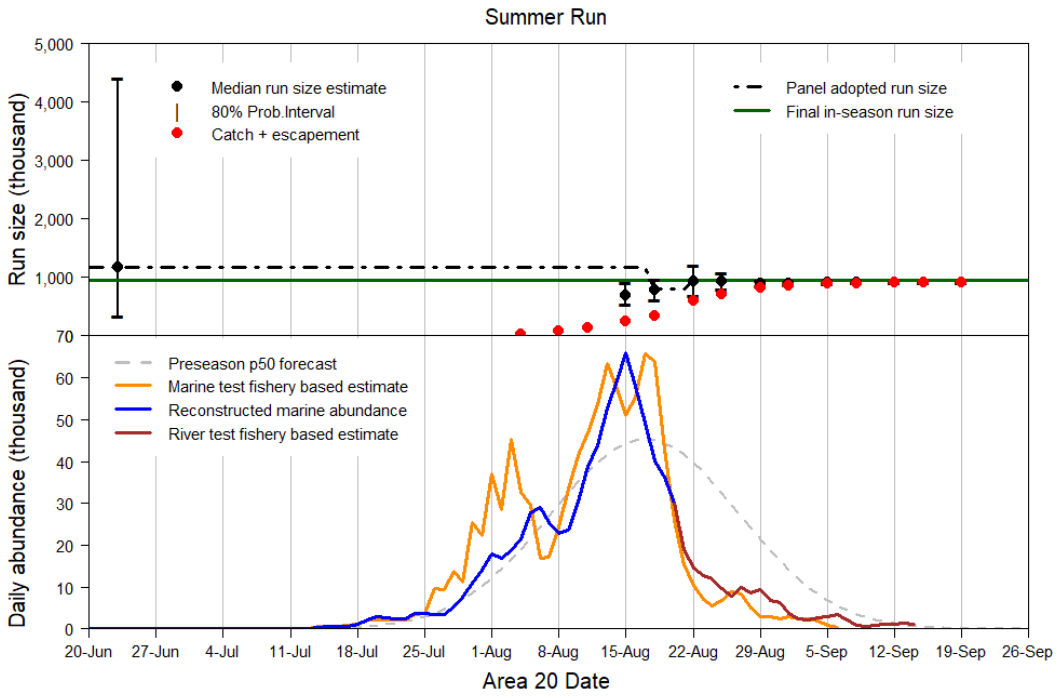

Figure F 3c: Daily reconstructed abundance estimates for Summer-run salmon and corresponding run size estimates at different times during the season.

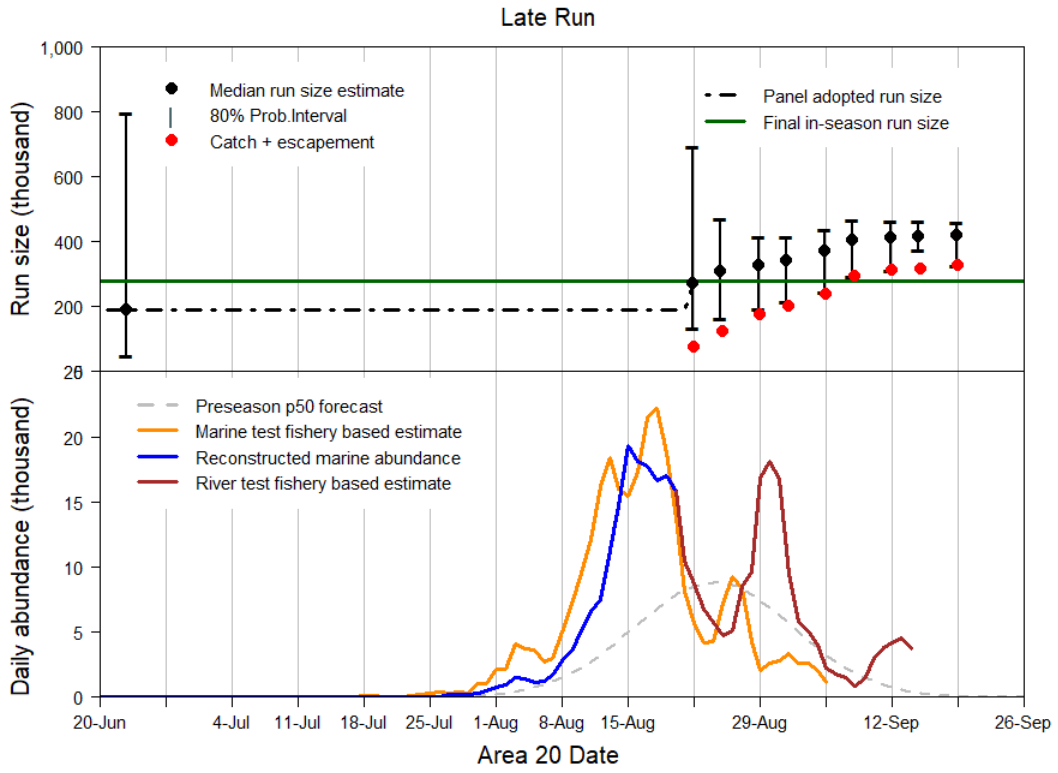

Figure F 3d: Daily reconstructed abundance estimates for Late-run salmon and corresponding run size estimates at different times during the season.

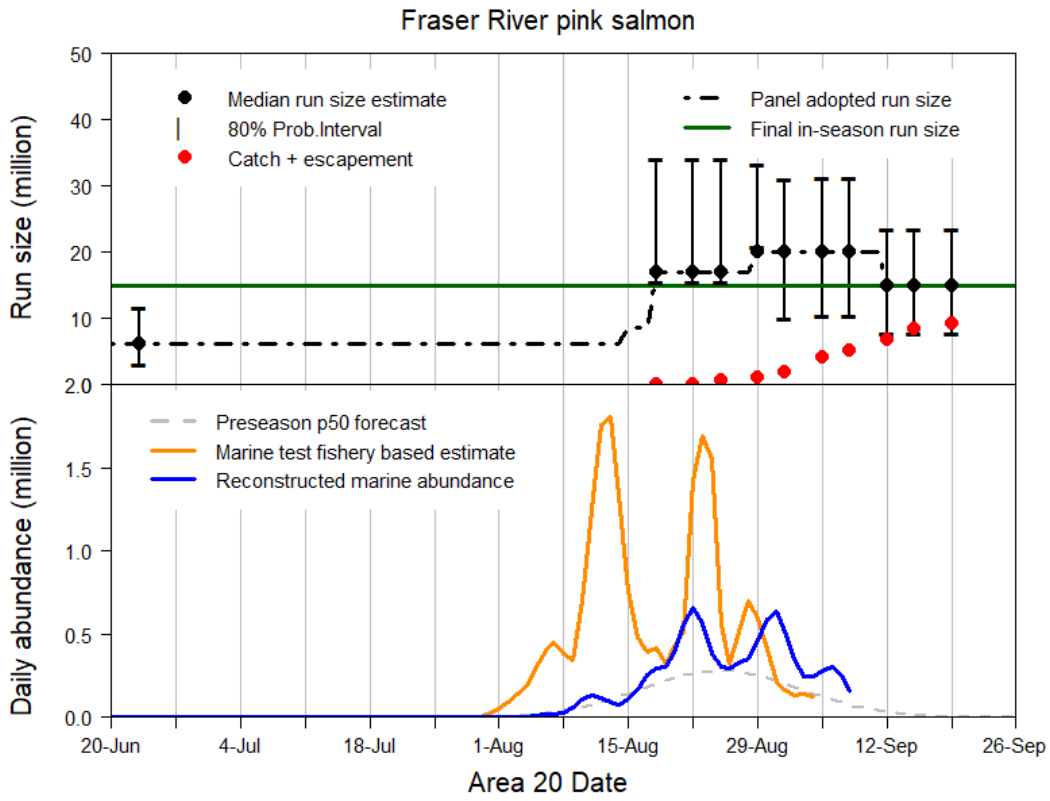

Figure F 3e: Daily reconstructed abundance estimates for Fraser River pink salmon and corresponding run size estimates at different times during the season.

Management Adjustment and DBE

Pre-season, the Environmental Watch (E-Watch) program at Fisheries and Oceans Canada presented a long-range forecast of Fraser River environmental conditions. The long-range (3-month) forecast provides lower Fraser River summer temperature and flow conditions using relationships between winter snowpack accumulation, summer air temperatures and river environmental conditions. The forecast was for below average discharge and above average water temperature in the Fraser River. The environmental forecast was applied to Environmental Management Adjustment (MA) models and, where applicable, to alternative pDBE forecast methods to forecast the proportional difference between estimates (pDBEs). A retrospective analysis was performed to identify the best performing model (Table 6). Based on the preliminary pDBE predictions, it is possible to predict how many additional sockeye should be allowed to escape to achieve spawning escapement objectives.[44]

Pre-season, the Panel chose to adopt the proportional Management Adjustments (pMAs) based on the best pre-season pDBE forecast method identified in the retrospective analysis (see Table 6). This resulted in the following, Management Adjustments (MAs, Table 1): 24,800 Early Stuart, 73,900 Early Summer, 240,700 Summer and 188,300 Late-run sockeye. These were added to the spawning escapement targets (SET) for pre-season planning purposes. For Early Stuart and Late run, the spawning escapement target (SET) equalled the run size at the median forecast abundance level.

[44] Forrest, M.R. and Hague, M.J. 2022. Management Adjustments. In: Michielsens, C.G.J. and Martens, F.J. Editors. Overview of pre-season and in-season assessment methods for Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 49, 179-184 p

This meant that spawning escapement targets for the Early Stuart and the Late run were unlikely to be reached, given the expected en-route losses and the proportional management adjustment (pMA) of 1.08 and 1.00 respectively (Table F3). For Early Summer and Summer run, the run size exceeded the SET but when including the MA, it resulted in a lack of harvestable surplus. As are result of the low preseason run size forecasts and the adopted MAs, all the management groups were in a Low Abundance Exploitation Rate (LAER) situation.

In-season, the Panel was presented with pDBE estimates for each management group (Table F3) based on the best performing in-season pDBE forecast method (Table 6) identified in the retrospective analysis. For Early Stuart sockeye, the best preforming model was the Threshold Approach that predicted larger en-route losses if the river temperature exceeded 17°C during their upstream migration. As a result, the Panel adopted the higher pMA of 1.70 (Table 7) associated with historical years when the temperature exceeded 17°C. The associated pDBE was -0.63. During the Early Summer run sockeye migration, river temperature was increasing, and discharge continued to decrease below the historical minima (1990-2020). The Panel was concerned with the impact of high temperatures and drought levels on the successful migration of the Early Summer run sockeye and questioned if models that work well on average were the best models to use under these conditions. A retrospective analysis of pDBE approaches in low discharge years, for Early Summer run, identified the 19-day Temperature and Discharge model as the best performing model in these conditions (Table F4). The Panel adopted the higher pMA of 1.08 (Table 7) associated with the predicted pDBE of -0.52 from the 19-day Temperature and Discharge model for Early Summer run. During the Summer run migration, the concern regarding drought levels remained. A retrospective analysis of pDBE approaches in low discharge years, for Summer run, identified that the pre-season pDBE Model using the pre-season long-range forecast provided by E-Watch was still the best performing model under these conditions (Table F4). The Panel stayed with the pre-season adopted pMA of 0.23 (Table 7) associated with the predicted pDBE of -0.19. Late run sockeye experienced above average temperatures for the time of year but delayed their upstream migration for 12 days. The Mission 50% date for Late run was September 6. The Panel stayed with the pre-season adopted pMA of 1.00 (Table 7) associated with the predicted pDBE of -0.50. This pDBE was based on the pDBE for Late run excluding Birkenhead/Big Silver group (-0.74) and the pDBE for the Birkenhead/Big Silver group (-0.25), weighted by their respective run size estimates.

Table F 3. Summary of the pre-season and in-season MA model predictions of %DBE for Early Stuart, Early Summer, Summer and Late-run management groups.

	Pre-season Best Performing Model Predictions[1]		In-season Best Performing Model Predictions[1]		Pre-season 31-day DBE Model Predictions[2]		19-Day DBE Model Predictions		In-season 31-day Model Predictions		In-season run-timing Model Predicitons[3]	
	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA
Early Stuart	-52%	1.08	-63%	1.70	-64%	1.78	-79%	3.76	-79%	3.76	NA	NA
Early Summer run	-36%	0.56	-52%	1.08	-50%	1.00	-55%	1.22	-68%	2.13	NA	NA
Summer run	-19%	0.23	-19%	0.23	-19%	0.23	-40%	0.67	-42%	0.72	NA	NA
Late run[4]	-50%	1.00	-50%	1.00	NA	NA	NA	NA	NA	NA	-43%	0.75

1 See Table (best performing model)

2 Pre-season MA Model Predictions use the Pre-season Forecast of Fraser River Temperature and Discharge from DFO's E-watch Program.

3 Mission 50% date is the final in-season hydroacoustic estimate of Sept. 6th.

4 Late run pDBE is based on a Weighted pDBE approach using the p50 forecast level of abundances

At Big Bar, discharge levels remained at or below the historical minima (1991-2020) throughout the sockeye migration. There were no upstream migration problems observed at the Big Bar slide site. Operation of the monitoring program ran from June 27 to July 31.

Spawning ground estimates of Fraser sockeye abundance totalled 918,200 sockeye, which implied a total Fraser observed %DBE of (-43%). The Early Summer run was the only management group to exceed its (SET). The Early Stuart, Early Summer, Summer and Late run sockeye (SET) was 41,000, 163,000, 926,000 and 300,000 sockeye respectively. High temperatures and drought conditions encountered in 2023 during the Fraser sockeye migration likely contributed to the observed DBEs and the failure to achieve escapement goals.

See Table F4 for a detailed summary of the Management Adjustment approaches by stock group.

Table F 4. Summary of the pre-season and in-season MA models and assumptions used during 2023 management season across management groups.

Management Group	Pre-season Predictor Variables	In-season Predictor Variables	Cycle lines Used	Excluded Years
Early Stuart	Historical Median (1995-2022)	Supplemental Approach (1977-2022)	All	1977, 1980, 1982, 1984, 1986, 2006, 2012, 2019, 2020
Early Summer run	Historical Median (1977-2022)	In-season 19-day model	All	1993, 2006,2019
Summer run	Pre-season 31-day model	Pre-season 31-day model	All	2002, 2006
Late run	Historical Median (1996-2021)	Historical Median (1996-2021)	2019, 2020, 2021	Dominant Cycle years (2022)

APPENDIX G: HISTORICAL CATCH, ESCAPEMENT AND PRODUCTION DATA

Table G 1. Catch by user group, spawning escapement, difference between estimates and run size of Fraser River sockeye salmon for cycle years 2013-2023.

	Fraser Sockeye Salmon			
	2011	2015	2019	2023
CANADIAN CATCH	**1,439,100**	**187,900**	**9,860**	**28,700**
Commercial Catch	**368,000**	**0**	**0**	**0**
Panel Area	160,800	0	0	0
Non-Panel Areas	207,200	0	0	0
First Nations Catch	**931,300**	**187,200**	**9,710**	**1,220**
Marine FSC	265,300	40,400	0	0
Fraser River FSC	584,800	146,800	9,710	1,220
Economic Opportunity	81,200	10	0	0
Non-commercial Catch	**139,800**	**620**	**150**	**4,940**
Marine Recreational	17,300	40	60	0
Fraser Recreational	84,300	40	0	0
Charter	4,240	550	80	710
ESSR	33,900	0	0	4,240
Other Catch	**0**	**0**	**0**	**22,500**
UNITED STATES CATCH	**297,200**	**150,600**	**78,100**	**2,210**
Washington Total	**278,800**	**46,200**	**470**	**2,210**
Commercial catch	**265,900**	**44,200**	**0**	**0**
Treaty Tribal	181,000	33,100	0	0
All Citizens	84,900	11,100	0	0
Non-commercial Catch	**12,900**	**2,020**	**470**	**2,210**
Ceremonial	12,900	2,020	470	2,210
Recreational	0	0	0	0
Other	0	0	0	170
Alaska*	**18,400**	**104,400**	**77,600**	**0**
TEST FISHING CATCH	**40,400**	**38,000**	**6,410**	**16,700**
PSC (Panel Areas)	**26,500**	**17,000**	**1,470**	**11,300**
Canada	24,700	12,400	1,470	11,300
United States	1,740	4,550	0	0
Canada (non-Panel Areas)	**14,000**	**21,100**	**4,950**	**5,340**
TOTAL RUN	**5,130,100**	**2,010,200**	**571,000**	**1,692,700**
Total Catch in All Fisheries	1,776,800	376,500	94,400	47,600
Adult Spawning Escapement	2,580,100	1,188,600	302,000	918,200
Jack Spawning Escapement	6,460	4,610	920	2,510
Difference between estimates	766,800	440,600	173,700	724,400
Percentage of Total Run	**100%**	**100%**	**100%**	**100%**
Total Catch in All Fisheries	35%	19%	17%	3%
Adult Spawning Escapement	50%	59%	53%	54%
Jack Spawning Escapement	0%	0%	0%	0%
Difference between estimates	15%	22%	30%	43%

*The preliminary 2023 Alaska catch of Fraser sockeye in D104 is estimated to be 7,775

Table G 2. Catch by user group, spawning escapement and run size of Fraser River pink salmon for cycle years 2017-2023.

	Fraser Pink Salmon			
	2017	2019	2021	2023
CANADIAN CATCH	**37,200**	**300,300**	**79,800**	**528,100**
Commercial Catch	**0**	**0**	**17,400**	**443,000**
Panel Area	0	0	17,300	435,100
Non-Panel Areas	0	0	100	7,900
First Nations Catch	**33,600**	**263,600**	**26,600**	**7,800**
Marine FSC	14,800	5,400	2,900	2,100
Fraser River FSC	18,900	37,200	7,700	4,600
Economic Opportunity	0	220,900	16,100	1,200
Non-commercial Catch	**3,500**	**36,700**	**35,700**	**77,300**
Marine Recreational	0	30,200	21,700	42,900
Fraser Recreational	0	5,700	13,700	33,700
Charter	3,500	700	300	600
ESSR	0	0	0	0
UNITED STATES CATCH	**102,200**	**233,300**	**196,000**	**428,900**
Washington Total	**102,200**	**233,300**	**196,000**	**428,900**
Commercial catch	**102,200**	**233,200**	**192,000**	**428,700**
Treaty Tribal	91,300	159,600	90,000	323,000
All Citizens	10,900	73,500	102,000	105,700
Non-commercial Catch	**0**	**100**	**3,900**	**200**
Ceremonial	0	100	3,900	200
Recreational	0	0	0	0
Alaska	**0**	**0**	**0**	**0**
TEST FISHING CATCH	**17,700**	**17,200**	**4,300**	**14,300**
PSC (Panel Areas)	**13,700**	**14,600**	**3,000**	**8,300**
Canada	11,800	14,400	3,000	6,000
United States	1,800	200	0	2,300
Canada (non-Panel Areas)	**4,000**	**2,700**	**1,300**	**6,000**
TOTAL RUN	**3,549,200**	**8,858,600**	**8,108,200**	**10,513,300**
Total Catch in All Fisheries	157,100	550,800	280,100	971,300
Adult Spawning Escapement	3,392,200	8,307,800	7,828,100	9,542,000
Percentage of Total Run	**100%**	**100%**	**100%**	**100%**
Total Catch in All Fisheries	4%	6%	3%	9%
Adult Spawning Escapement	96%	94%	97%	91%

Table G 3. Escapements of sockeye salmon to Fraser River spawning areas for cycle years 2011-2023*

DISTRICT / Stock Group / Stream/Lake	Year 2011		2015		2019		2023	
NORTHEAST								
Upper Bowron R.	4,101		3,845		20		2,508	1
STUART								
Early Stuart								1
Driftwood R.	12		726		0		2,271	
Takla L. Streams	229		2,641		28		2,968	
Middle R. Streams	415		5,144		53		3,245	
Trembleur L. Streams	101		1,403		8		1,335	
Miscellaneous	0		173		0		0	
Late Stuart								1
Kazchek Cr.	16		0		11		0	
Kuzkwa Cr.	569		533		358		468	
Middle R.	564		3,605		877		5,337	
Tachie R.	2,318		6,822		4,441		14,565	
Miscellaneous	316		164		114		115	
NECHAKO								
Nadina R. (Late)	3,535		10,912		16,575		86,176	
Nadina Channel	6,521		23,506		6,621		24,699	
Stellako R.	85,174		101,255		45,940		107,430	
QUESNEL								
Horsefly R.	29,952		23,928		14,413		48,912	
Horsefly Channel	2,362		4,315		28		0	
McKinley Cr.	72		228		659		1,172	
Mitchell R.	11,558		13,009		4,466		11,435	
Miscellaneous	1,527		4,198		2,034		5,471	
CHILCOTIN								
Chilko R. & L.	916,643		660,600		168,121		344,615	
Chilko Channel	0		0		0		0	
Taseko L.	964		980		0		1,992	1
SETON-ANDERSON								
Gates Cr.	38,153		11,594		7,287		17,667	
Gates Channel	17,707		6,669		2,274		0	
Portage Cr.	1,114		36		520		3,438	
NORTH THOMPSON								
North Thompson R.	4,929		24,004		353		8,282	
Raft R.	9,241		16,054		619		10,625	
Fennell Cr.	9,988		1,420		524		2,141	
SOUTH THOMPSON								
Early Summer-run								
Scotch Cr.	33,807		6,614		1,719		5,341	
Seymour R.	16,456		7,897		1,180		6,235	
Upper Adams / Momich / Cayenne	552		211		18		191	
Miscellaneous	15,508		12,486		2,246		5,863	
Late-run								
Adams R.	148,175		5,485		1,960		4,851	
Little R.	3,956		229		335		155	
Lower Shuswap R.	11,068		3,057		2,217		2,097	
Miscellaneous	2,496		917		751		739	
HARRISON-LILLOOET								
Birkenhead R.	227,742		44,973		2,998		75,695	
Big Silver Cr. & misc. Birk. types	16,942		8,993		67		3,649	
Harrison R.	805,596		115,684		3,813		34,185	
Weaver Cr.	26,938		1,130		92		23,440	
Weaver Channel	45,631		1,884		1,714		15,026	
LOWER FRASER								
Nahatlatch R. & L.	6,955		4,414		1,288		5,822	
Cultus L.	7,201	1	1,309	1	68	1	80	1
Upper Pitt R.	55,997		38,478		3,507		21,593	
Chilliwack L./Chilliwack R., upper	4,479		6,589		1,347		5,380	
MISCELLANEOUS	2,551	2	421		301		226	
ADULTS	2,580,131		1,188,535		301,965		917,435	
JACKS	6,464		4,607		919		2,818	
TOTAL NET ESCAPEMENT	2,586,595		1,193,142		302,884		920,253	

* Estimates are from DFO.

1 Cultus estimates include 253 in 2011, 196 in 2015, 45 in 2019 and 31 in 2023 removed for broodstock. For 2023, additional broodstock was taken for Early Stuart, Bowron, Taseko and Late Stuart: 239, 46, 44, and 88, respectively.

2 'Miscellaneous' category includes fish from small stocks throughout the Fraser watershed.

Table G 4. Fraser River pink salmon production for odd brood years in 1961-2021 (return years 1963-2023).

Brood Year	Spawners		Potential Egg Deposition		Fry Production		Adult Returns (Catch + Escapement)		% Survival		Average To Date
	Total (millions)	Female (millions)	(millions)		(millions)		(millions)		Fresh Water	Marine	
(by)	*(by)*	*(by)*	*(by)*		*(by+1)*		*(by+2)*				
1961	1.092	0.654	1,569		143.6		5.482		9.2%	3.8%	3.8%
1963	1.954	1.216	2,435		284.2		2.320		11.7%	0.8%	2.3%
1965	1.194	0.692	1,488		274.0		12.963		18.4%	4.7%	3.1%
1967	1.831	0.973	2,132		308.0		3.931		14.4%	1.3%	2.7%
1969	1.531	0.957	2,018		287.7		9.763		14.3%	3.4%	2.8%
1971	1.805	1.096	1,923		273.6		6.801		14.2%	2.5%	2.8%
1973	1.754	1.009	1,865		212.3		4.894		11.4%	2.3%	2.7%
1975	1.367	0.781	1,493		319.7		8.209		21.4%	2.6%	2.7%
1977	2.388	1.362	2,960		483.7		14.404		16.3%	3.0%	2.7%
1979	3.561	2.076	3,787		341.3		18.685		9.0%	5.5%	3.0%
1981	4.488	2.560	4,814		607.0		15.346		12.6%	2.5%	2.9%
1983	4.632	2.931	4,702		557.4		19.038		11.9%	3.4%	3.0%
1985	6.461	3.561	5,900		264.5		7.172		4.5%	2.7%	3.0%
1987	3.224	1.856	3,471		436.0		16.484		12.6%	3.8%	3.0%
1989	7.189	4.383	7,198		400.4		22.174		5.6%	5.5%	3.2%
1991	12.943	8.002	12,330		685.5		16.983		5.6%	2.5%	3.1%
1993	10.768	6.454	9,192		437.7		12.904		4.8%	2.9%	3.1%
1995	7.175	4.248	10,233		279.1		8.176		2.7%	2.9%	3.1%
1997	2.842	1.740	2,863		257.5		3.608		9.0%	1.4%	3.0%
1999	3.445	1.885	2,702		219.0		21.262		8.1%	9.7%	3.4%
2001	19.814	9.543	16,274		714.4		24.250		4.4%	3.4%	3.4%
2003	n/a	n/a	n/a	*1*	419.0		9.870	*3*	n/a	2.4%	3.3%
2005	n/a	n/a	n/a	*1*	614.5		8.490	*3*	n/a	1.4%	3.2%
2007	n/a	n/a	n/a	*1*	497.0		19.936	*3*	n/a	4.0%	3.3%
2009	15.429	n/a	n/a	*1*	1062.4		20.649	*4*	n/a	1.9%	3.2%
2011	12.788	n/a	n/a	*1*	519.3		15.898	*4*	n/a	3.1%	3.2%
2013	9.344	n/a	n/a	*1*	609.4		5.779	*4*	n/a	0.9%	3.1%
2015	5.369	n/a	n/a	*1*	230.0		3.550	*4*	n/a	1.5%	3.1%
2017	3.392	n/a	n/a	*1*	192.0		8.858	*4*	n/a	4.6%	3.1%
2019	8.307	n/a	n/a	*1*	n/a	*2*	8.107	*4*	n/a	n/a	n/a
2021	7.841	n/a	n/a	*1*	226.0	*2*	10.513	*4*	n/a	4.7%	3.2%
2023	8.841	n/a	n/a	*2*	n/a						
Average	5.958	2.761	4,826		411.4		11.866		10.6%	3.1%	

1 No on the grounds surveys

2 Estimates of fry production unavailable due to COVID19.

3 Estimates of adult returns between 2005-2009 (2003-2007 brood years) are less certain because pink salmon escapement enumeration programs were not conducted. Instead, estimates of adult returns for these years are based on in-season abundance estimates by the PSC.

4 Estimates of escapements for the 2009 - 2021 return years are from the PSC's Mission hydroacoustics program.

Table G 5. Detailed calculation of total allowable catch (TAC) and achievement of international catch shares for Fraser sockeye (by management group) salmon in 2023. Calculations are based on the in-season estimates of abundance, spawning escapement target and Management Adjustment at the time the Panel adopted the last in-season run size (September 27), in accordance with Annex IV, Chapter 4 of the Pacific Salmon Treaty.

	Fraser Sockeye							Fraser Pinks	
	Early Stuart	Early Summer	Summer	Late	Total				
RUN STATUS, ESCAPEMENT NEEDS & AVAILABLE SURPLUS									
In-season Abundance Estimate	**41,000**	**326,000**	**926,000**	**359,000**	**1,652,000**			**10,300,000**	
Adjusted Spawning Escapement Target *	**41,000**	**326,000**	**926,000**	**359,000**	**1,652,000**			**6,000,000**	
Spawning Escapement Target (SET)	41,000	163,000	926,000	300,000	1,430,000			6,000,000	
%SET from TAM rules	*100%*	*50%*	*100%*	*84%*				1	
Management Adjustment (MA)	69,700	176,000	213,000	300,000	758,700			n/a	
Proportional MA (pMA)	*1.70*	*1.08*	*0.23*	*1.00*					
Test Fishing Catch (TF, post-seas. est.)	200	4,000	9,900	2,600	16,700			14,300	
Surplus above Adjusted SET & TF *	**0**	**0**	**0**	**0**	**0**			**4,285,700**	
DEDUCTIONS & TAC FOR INTERNATIONAL SHARING									
Aboriginal Fishery Exemption (AFE)	**0**	**0**	**0**	**0**	**0**			**n/a**	
Total Deductions (Adj.SET + TF + AFE)	41,200	330,000	935,900	361,600	1,668,700			6,014,300	
Available TAC (Abundance - Deductions)	**0**	**0**	**0**	**0**	**0**			**4,285,700**	
UNITED STATES (Washington) TAC									
Propor. distrib. TAC - Payback	**0**	**0**	**0**	**0**	**0**			**1,101,400**	
Proportionally distributed TAC **	0	0	0	0	0	16.5%		1,101,400	25.7%
U.S. Payback	0	0	0	0	0			0	
Washington Catch	0	0	1,100	1,100	2,200			428,900	
Other Catch***	0	6	82	86	174				
Deviation from TAC - Payback	**0**	**0**	**-1,200**	**-1,200**	**-2,400**			**672,500**	
CANADIAN TAC									
Propor. distrib. TAC + Payback + AFE	**0**	**0**	**0**	**0**	**0**			**3,184,300**	
Propor. distrib. TAC + U.S. Payback	0	0	0	0	0	83.5%		3,184,300	74.3%
AFE	0	0	0	0	0			0	
Other Catch***	500	2,400	19,500	200	22,600				
Canadian Catch excluding ESSR Catch	500	2,600	21,100	300	24,500			528,100	
Deviation from TAC + Payback + AFE	**-500**	**-2,600**	**-21,100**	**-300**	**-24,500**			**2,656,200**	
TOTAL									
Available TAC + U.S. Payback + AFE	**0**	**0**	**0**	**0**	**0**			**4,285,700**	
Total Catch excluding ESSR Catch	500	2,600	22,300	1,500	26,800			957,000	
Deviation from TAC + U.S. Payback + AFE	**-500**	**-2,600**	**-22,300**	**-1,500**	**-26,800**			**3,328,700**	

* The surplus cannot exceed the estimated abundance.

** Washington sockeye and pink shares according to Annex IV, Chapter 4 of the Pacific Salmon Treaty.

*** May include unauthorized directed retention or unauthorized bycatch retention in fisheries directed at other species

Review of August 18 and 25, 2023 Fraser River Panel fisheries proposals, decisions and subsequent consequences

PSC Secretariat

December 20, 2023

Table of Contents

Executive Summary 3

Introduction 5

Report terminology - glossary 5

Differences in interpretation of Annex IV, Chapter 4, paragraph 3e, 3g 6

Interpretation of the Treaty language in 2023 7

Implementation of the Treaty in past years 10

Consequences of U.S. fisheries in 2023 12

U.S. catches and sockeye mortality 12

Impact of U.S. fisheries on achieving FRP management objectives 14

Relevant information for in-season FRP fisheries decisions 16

Factors relevant to sound fisheries management decisions 16

Recommendations 22

References 27

Appendix 1: Pre-season fishing plans and in-season U.S. fisheries decisions 28

Appendix 2: Rationale letter in support of U.S. fisheries as adopted on August 18, 2023 37

Appendix 3: Rationale letter in support of U.S. fisheries as adopted on August 25, 2023 42

Appendix 4: Canadian response to August 18 and August 25, 2023 rationale letters 47

Appendix 5: Canadian request for a report on the 2023 season 50

Executive Summary

Catches and run size are subject to changes with future updates. Values in this report are current as of December 1, 2023.

Background

- In 2023, Canada and the U.S.A. disagreed on the interpretation of the Treaty, in particular Annex IV, Chapter 4, paragraph 3e and 3g.
- On August 18, the U.S. proposed pink-directed Treaty Tribal Ceremonial and Subsistence (C&S) fisheries with retention of sockeye. The U.S.A. considered the incidental harvest rate of sockeye small but acceptable and in accordance with the Treaty.
- On August 25, the U.S.A. proposed pink-directed Treaty Tribal and All Citizen fisheries with non-retention of sockeye and considered the fisheries induced mortality of sockeye salmon small but acceptable and in accordance with the Treaty.
- Canada did not approve of these U.S. fisheries proposals.
- While acknowledging objections of Canada, the Panel approved the U.S. fisheries proposals as allowed under Chapter 4, paragraph 13(d).

Differences in interpretation of Annex IV, Chapter 4, paragraph 3e and 3g (PSC, 2020)

- Canadian perspective: No fisheries in Panel waters should retain sockeye when there is no sockeye TAC (Appendix 4).
- U.S.A. perspective: If the incidental harvest of sockeye is small but acceptable, sockeye can be retained even if there is no TAC (Appendix 2).
- Canada: Choices of fishing area, gear and retention should prioritise meeting sockeye escapement targets and not incur unnecessary sockeye mortalities (Appendix 4).
- U.S.A.: Canada's requests for modifications to fishing gear (no or modified gillnets), fishing area (no fishing in the Apex) and sockeye non-retention are domestic fisheries management decisions and outside the purview of Chapter 4 (Appendix 2 and 3)
- In past years without sockeye TAC, exploitation rates including Fishery-Induced Mortalities (FIMs) have ranged from 18.73% in 2016 to 3.82% in 2019 (compared to 2.42% in 2023) and included the use of U.S. drift gillnets in all previous years, closure of the Apex in more recent years and some level of sockeye retention, by Canada and/or Washington, across all years.

Consequences of the U.S. fisheries in 2023

- As requested by Canada (Appendix 5), this report by PSC staff provides information to help the Parties determine if the incidental sockeye fishing mortality rate by pink-directed U.S. fisheries should be considered small but acceptable, but does not draw any conclusions, given that the evaluation of what should be considered small but acceptable falls outside the roles and responsibilities of PSC staff (FRP Roles & Responsibilities, 2023).

Sockeye and pink salmon catches and fishing mortality

- Following the August 18 FRP meeting, the U.S.A. caught and retained 2,371 Fraser River sockeye in pink-directed Treaty Tribal C&S fisheries. The majority were caught using purse seine gear while 39 were caught with drift gillnets, and 160 were retained without the proper authorisation.
- Overall in the 2023 fishing season, 436,000 Fraser River pink salmon were caught in pink-directed U.S. fisheries.

- The associated sockeye mortality including 872 FIMs was 3,243 fish for the 2023 U.S. Fraser pink salmon fishery, which represented a sockeye exploitation rate of 0.19% based on a final in-season Fraser River sockeye salmon run size estimate of 1.7 million.
- Assuming the U.S. fisheries would not have retained sockeye and drift gillnet gear would not have been used, the associated estimated sockeye mortality would have gone down from 3,243 to 1,575 fish, which represents a sockeye exploitation rate including FIMs of 0.09%.
- The impact of closure of the Apex is uncertain as we have limited information on fish abundance in the Apex compared to the rest of Area 7A but:
    - It is not expected to be substantial for the entire Late run management group, including non-delaying Birkenhead, Big Silver stocks, given that estimated Late run proportions in the Strait of Georgia in 2023 were similar to Late run proportions in Juan de Fuca Strait.
    - The estimated proportion of delaying Late run stocks (e.g., Late Shuswap, Weaver) however was 10 times higher in the Strait of Georgia than in Juan de Fuca Strait.

Impact of U.S. fisheries on achieving FRP management objectives

- To be able to judge if the incidental U.S. harvest of sockeye can be considered small but acceptable, it is important to evaluate the extent to which these fisheries prevented the Panel from achieving its fisheries management objectives.
- Achievement of spawning escapement targets:
    - Based on post-season predictions and still lacking spawning ground information, none of the sockeye Spawning Escapement Targets (SET) are expected to be met for 2023: Early Stuart is 63% below target, Early Summer run 6% below, Summer run 21% below and Late run 41% below. Fraser River pink salmon escapement is expected to be 60% above the SET.
    - Sockeye fishing mortalities had a relatively small impact on the ability to reach SETs compared to natural mortalities associated with environmental conditions in the Fraser River. If the U.S. fisheries would not have retained sockeye and not used drift gillnet gear, the impact on achieving SETs would have been limited, e.g., the Late run escapement would be 41.02% below target instead of 41.11%.
- Achievement of Total Allowable Catch (TAC) targets:
    - There was no sockeye TAC, resulting in the need for Canada and the U.S.A. to assess if the incidental harvest of sockeye in pink-directed fisheries was small but acceptable.
    - Across management groups, the U.S. sockeye exploitation rates including FIMs were: 0% for Early Stuart, 0.01% for Early Summer run, 0.16% for Summer run and 0.47% for Late run.
    - The overall sockeye exploitation rates including Canadian and test fishing catches and FIMs were: 1.16% for Early Stuart, 2.10% for Early Summer run, 2.89% for Summer run and 1.66% for Late run, which were all below the Low Abundance Exploitation Rates (LAERs) of 10%, implemented when there is no sockeye TAC.
    - Overall, the U.S. fisheries caught 436,000 Fraser River pink salmon, which represents 10% of the total post-season pink salmon TAC, or 40% of their allocated share of 25.7%.
- Achievement of domestic allocation goals
    - Both Treaty Tribes and All Citizen fisheries caught less than their domestic shares of the U.S. pink salmon TAC.

Relevant information for in-season FRP fisheries decisions

- For this report, Canada requested that the PSC staff evaluate and recommend factors relevant to making sound fisheries management decisions and to inform the trade-off between incidental sockeye mortality and directed pink salmon harvest (Appendix 5).
- PSC staff evaluated stock and species composition in the proposed fishing area, availability to the fishing gear, encounter rates, gear selectivity, release mortality rates and sockeye mortality rates.
- PSC staff provided a set of recommendations (this document) which will require further discussion with both the Panel and Technical Committee in terms of the extent they should be implemented.

Introduction

During Fraser River Panel regulatory control in 2023, the United States prosecuted fisheries that Canada objected to under the provisions of Annex IV, Chapter 4, paragraph 13(d)(iii), on August 18 and August 25, 2023. Pursuant to the same paragraph, the United States provided rationale for these fisheries via correspondence to the PSC Executive Secretary, Mr. John Field, on August 19, 2023 (U.S. rationale, Appendix 2) and on August 25, 2023 (U.S. rationale, Appendix 3). On October 6, 2023, the Panel's Canadian Chair sent a response to the rationale letters to the Panel's U.S. Vice Chair (Canadian response, Appendix 4). The same day, Canada corresponded with the Executive Secretary requesting an objective report on the circumstances of the fishery and its consequences pursuant to Chapter 4, paragraph 13(e) (Canadian report request, Appendix 5). This report responds to that request.

More specifically this report documents 1) the differences in interpretation of Annex IV, Chapter 4, paragraph 3e and 3g between Canada and the U.S.A., 2) how the Treaty language was interpreted in 2023 compared to other non-dominant years with limited or no sockeye TAC, and 3) what the consequences were of the U.S. fisheries in 2023 in terms of U.S. catches, sockeye mortality, and the achievement of Fraser River Panel management objectives. **It should be stressed that the evaluation of small but acceptable incidental sockeye harvest rates falls outside the roles and responsibilities of PSC staff (FRP Roles & Responsibilities, 2023). Therefore, while this report provides information relevant to the evaluation of incidental sockeye mortality in pink-directed U.S. fisheries, the report provides no conclusions in this regard.** In response to Canada's request, the report contains a discussion of factors other than run size that could be of relevance to sound fisheries management decisions, including factors that could inform the trade-off between incidental sockeye mortality and directed pink salmon harvest. Finally, the report contains a list of recommendations in response to Canada's request.

In addition to the listed material, Appendix 1 of this report contains necessary background information regarding the 2023 season. This consists, more specifically, of a description of the pre-season planning and in-season FRP meetings during which the proposed U.S. fisheries were evaluated.

Report terminology - glossary

There exists confusion around different terms used for fisheries management and some are used interchangeably even though they mean different things. The following glossary has been assembled for this document to ensure there is a common understanding of terms used in this report. The definitions used in this report do not, however, imply agreement of both parties on the definitions. The recommendations in this report will touch on ensuring bilateral agreement on fisheries management terms moving forward.

Harvest rate – the proportion of the vulnerable population removed by the fishing gear, i.e., fish of a given species removed by the fishery from the total abundance of that species available in the fishing area. Harvest rates focus on the direct removal of fish from the population and do not include indirect effects of the fishing activity such as fishery-induced mortalities.

Catchability – refers to the relationship between the rate at which fish are caught (catch rate) and the true population size. Catchability depends on two components: a species availability in the fishing area and the effectiveness or efficiency of the gear in capturing the species, i.e., the species vulnerability to capture.

Encounter rate – the proportion of the vulnerable population that makes contact with the fishing gear, resulting in either retention or release.

Exploitation rate – the removal of fish from the population through fishing activities, including dead bycatch discards. It is also termed the fishing mortality rate and calculated as the sum of all fishing-related mortalities (landed catch + fishery-induced mortality) divided by the total run size.

Incidental catch – fish that were unintentionally caught while targeting other species. This catch is also termed bycatch.

Incidental harvest rate – proportion of the vulnerable population unintentionally removed by the fishing gear while targeting a different species or population.

Discarded catch – fish released back in the water, because retention of these fish is not allowed due to conservation concerns or because of the limited value attached to these fish.

Fishery-induced mortality (FIM) – term used in the Fraser River Panel process for fish killed by the fishing gear but not counted as catch, because they are not retained. This includes mortality of fish that encounter the gear but are not captured (e.g., escapement mortality), that are dead or die during capture (e.g., on-board mortality) or that die after release (e.g., post release mortality). This is also termed fishing-related incidental mortality (FRIM) (DFO 2016).

Release mortality – fish that are released back in the water and die due to injury from gear or handling. In the Fraser River Panel Process, release mortality is often used as a synonym for fishery-induced mortality (FIM), even though the latter can be viewed as a more inclusive term.

Natural mortality – the removal of fish from a population due to causes not associated with fishing e.g., high water temperature, high water discharge, predation, diseases, pollution, or any other non-fishing factors that can prevent a fish from reaching its spawning grounds.

Total mortality – sum of the fishing mortality and natural mortality.

Available Total Allowable Catch (TAC) – the run size minus escapement target, minus management adjustment, minus the agreed test fishing deduction, and minus the Aboriginal Fisheries Exemption.

Harvestable surplus – the run size minus escapement target, minus management adjustment, and minus the agreed test fishing deduction. In case there is harvestable surplus but no TAC available, then only Canadian Food, social and ceremonial (FSC) fisheries can occur to the extent indicated by the Aboriginal Fisheries Exemption.

Differences in interpretation of Annex IV, Chapter 4, paragraph 3e, 3g

Disagreement between both Parties in 2023 stems from different interpretations of the Treaty language, in particular Annex IV, Chapter 4, paragraph 3e and 3g (PSC 2023):

3e) "Each Fraser River sockeye stock is assigned to one of four stock management groups. The stock management groups are Early Stuart, Early Summer, Mid-Summer and Late Run. The annual U.S. share of sockeye available for harvest in the Panel Area is calculated by applying the percentage

share provided in paragraph 2(a) to the aggregate TAC, defined as the sum of the TACs calculated for each of the four stock management groups. To the extent practicable, the Panel shall develop and implement a fishing plan that provides the U.S. fishery with the opportunity to harvest its 16.5 percent aggregate share of the TAC of Fraser River sockeye. To accomplish this, the Panel to the extent practical, shall strive to concentrate the U.S. sockeye fishery on the most abundant management group (or groups), i.e., those that provide the largest percentage of the available TAC. It is understood that, despite concentrating the U.S. harvest in this manner, the overlapping of management groups may result in more than 16.5 percent of the TAC for one or more of the less abundant management groups being harvested by the U.S. fishery. A small but acceptable rate of incidental harvest may occur on one or more overlapping management groups that have little or no TAC as defined in this Chapter".

3g) "To the extent practicable, the Panel shall develop and implement a fishing plan that provides the U.S. fishery with the opportunity to harvest its 25.7 percent share of the Fraser River pink salmon TAC. To accomplish this, the Panel shall take into consideration the availability of both the sockeye salmon TAC and pink salmon TAC, through the entire fishing season, while to the extent practical, minimizing the impacts on overlapping sockeye management groups with little or no TAC. It is understood that the overlapping of sockeye and pink salmon migrations may result in a small but acceptable rate of incidental harvest on one or more overlapping sockeye management groups that have little or no TAC as defined in this Chapter".

These paragraphs have been part of the Treaty language since 2014 (PSC 2014) and their wording did not change with the renegotiation of the Treaty in 2019 (PSC 2023). What has changed substantially since 2014 is the prevalence of international TAC for sockeye. Since the implementation of the Treaty in 1985, there have been only two years without sockeye TAC prior to 2014 (2007 and 2009), whereas 66% of the years since 2014 have had no international sockeye TAC.

Interpretation of the Treaty language in 2023

Canada and the U.S.A. disagree on the interpretation of these paragraphs when there is no international TAC for sockeye salmon (Table 1). Canada interprets paragraphs 3e and 3g as saying that if there is no Total Allowable Catch (TAC) available, no fisheries should be designed to retain sockeye salmon (Appendix 4). The U.S.A. interpreted "incidental harvest" of sockeye to mean the incidental catch of sockeye in fisheries targeting pink salmon and permitting their retention, even if there is no sockeye TAC available, as long as the resulting incidental harvest is considered small but acceptable (Appendix 2).

Table 1: PSC staff **overview** of differences in interpretations by Canada (Appendix 4) and the U.S.A. (Appendix 2 and 3) of the Pacific Salmon Treaty Annex IV, Chapter 4, paragraph 3e and 3g (PSC, 2020).

U.S. interpretation	Canadian interpretation
• The U.S.A. interprets the Treaty to allow sockeye retention, even if there is no sockeye TAC available, as long as the resulting incidental harvest is considered small but acceptable. • The proposed U.S. fisheries of August 18 (with sockeye retention) were expected to result in a sockeye exploitation rate of 0.44% (0.04% ER for Early Summer, 0.55% for Summer, and 0.71% ER for Late run sockeye). • The proposed U.S. fisheries of August 25 (no sockeye retention) were expected to result in a sockeye mortality rate, including FIMs, of 0.06% sockeye (0.00% ER for Early Summer, 0.06% for Summer, and 0.10% ER for Late run sockeye). • The U.S.A. viewed these incidental sockeye harvest rates as small but acceptable. • The U.S.A. viewed gear, area, and retention regulations to be domestic decisions and viewed Canada's requests for modifications to be outside the purview of Chapter 4. • The U.S.A. also viewed non-retention regulations as not practicable to U.S. Tribes.	• Canada's view of small but acceptable incidental harvest is that no fisheries in Panel waters should retain sockeye when no sockeye TAC is available. • When fisheries have been designed, to the extent practical, to avoid incidental mortality, some sockeye mortality may occur. • Choices of fishing area, gear and retention should prioritize meeting escapement targets for sockeye salmon and not incur unnecessary sockeye mortalities. • In Canada's view, insufficient efforts, to the extent practicable, were made to minimize impacts of U.S. pink-directed fisheries on sockeye salmon. • As a result, the incidental harvest of sockeye salmon, caught and retained in the proposed August 18 fisheries as well as the FIMs in the proposed August 25 fisheries, were not acceptable to Canada.

Both countries agree that the definition of "small but acceptable" is context specific. Canada's view is that, if there is no Total Allowable Catch (TAC) available, "no fisheries in Panel waters should be designed to retain sockeye salmon. Where fisheries have been designed to the extent practicable, to avoid incidental mortality, it is understood that some sockeye mortality may occur" (Appendix 4). It is Canada's view that, if there is no TAC, fisheries management choices about area, gear and sockeye retention should prioritise meeting sockeye escapement targets and should be designed, to the extent practicable, to avoid incidental sockeye mortalities (Appendix 4). The U.S.A. views Canada's requests regarding the release of incidentally caught sockeye, modifications to the fishing gear used and reduced fishing areas to be domestic fishery management decisions and "outside the purview of Chapter 4, including intertribal allocation concerns, and well beyond the language regarding small but acceptable incidental harvest" (Appendices 2 and 3). In addition, the U.S.A. viewed Canada's initial request to release incidentally caught sockeye as not practicable given the U.S. Tribes cultural beliefs. Figure 1 provides an overview of the current Fraser River Panel process to approve U.S. fisheries proposal and highlights the different U.S.A. and Canadian views on the evaluation of U.S. fisheries proposals.

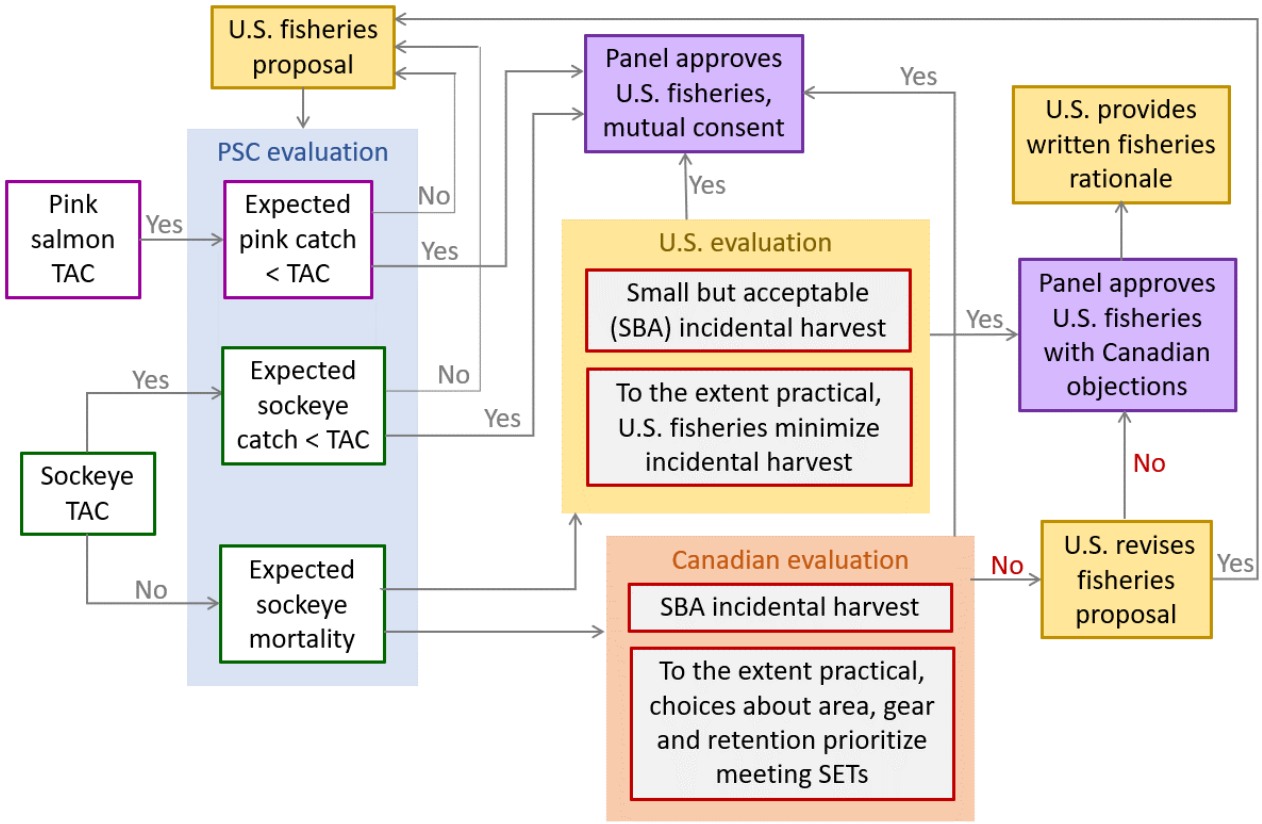

Figure 1: Overview of the current Fraser River Panel process to evaluate and approve U.S. fisheries proposals. In cases where there are both sockeye and pink salmon TACs, approval depends on the comparison of the predicted catch against the available TACs. In cases where there is available pink salmon TAC but there is no sockeye salmon TAC, the sockeye mortality incurred by the U.S. fishery proposal is evaluated by the U.S.A. and Canada relative to each country's interpretation of "small but acceptable". According to the Treaty (PSC 2023), the Panel can approve U.S. fisheries proposals, with or without Canadian consent, as long as the predicted catch of the target species is below the available TAC, regardless of the Canadian evaluation. The same process is used to evaluate Canadian fisheries.

Canada did not approve of the U.S. fisheries proposals on August 18 and August 25, 2023. More specifically, Canada did not approve U.S. fisheries using drift gillnet gear and expressed concern that the mesh sizes being used in these pink-directed fisheries were more suitable for catching sockeye than pink salmon. The U.S.A. instead focused on prohibiting the commercial sale of sockeye and restricting the fishery to daylight hours to limit the effectiveness of the drift gillnet gear, to ensure limited fishing effort and to achieve a small but acceptable incidental harvest of sockeye in this fishery.

Similarly, Canada did not approve of U.S. fisheries that allowed fishing in the Apex[1] (the most northwest section of the U.S. Panel Area waters in the Strait of Georgia), given the potential for higher proportions of Late run sockeye that delay their upstream migration into the Fraser River. In particular, Late Shuswap, Portage, Weaver and Cultus may delay in Canadian Pacific Fisheries Management Areas (PFMAs) 29-3, 29-4 and in the Apex of U.S. Area 7A. The U.S.A views "the Canadian insistence of the U.S.A. closing the Apex, to protect the Late run sockeye group, not supported by the very small number of sockeye, in total, forecast

[1] The Apex is those waters north and west of the Area 7A "East Point Line," defined as a line projected from the low water range marker in Boundary Bay on the International Boundary through the east tip of Point Roberts in the State of Washington to the East Point Light on Saturna Island in the Province of British Columbia.

to be impacted by the U.S. fisheries, and given that the fisheries are already releasing all sockeye encountered" (Appendix 3). In addition, the Canadian request to close the Apex to protect Late run sockeye is inconsistent with "how the Apex closure has been implemented in the past, usually involving fishing that retains sockeye" (Appendix 3).

Finally, Canada did not approve of the retention of sockeye in U.S. Treaty Tribal Ceremonial and Subsistence (C&S) fisheries using both drift gillnet and purse seine gear, given that Canada considered the retention of sockeye in pink-directed fisheries to incur unnecessary sockeye mortalities. The U.S. section did not consider the non-retention of sockeye in pink-directed fisheries as practicable given that "the U.S. tribes have cultural and religious beliefs, enshrined in their respective laws and fishing regulations, that require their fishers to retain all catch, including bycatch, for sampling purposes and to prevent wastage" (Appendix 3). Despite cultural and religious beliefs among U.S. Tribes, the U.S.A. agreed to implement non-retention of sockeye in all fisheries proposed at the August 22 Panel meeting" (Appendix 3) and all subsequent meetings in 2023.

Although both countries believe a small but acceptable rate of incidental sockeye harvest depends on national contexts, they were able to develop bilaterally-agreed fisheries plans pre-season via the fisheries planning model. Despite in-season conditions being somewhat similar in comparison to pre-season expectations (similar total sockeye run size, no international TAC or harvestable surplus), both Parties were unable to agree on what constituted small but acceptable under these contexts. While PSC staff cannot and should not weigh in what constitute a small but acceptable incidental sockeye harvest rate, it is possible to review what both Parties considered small but acceptable in past years without TAC or harvestable surplus and how those years compare to 2023.

Implementation of the Treaty in past years

While there may be disagreements about interpretation of the Treaty language, there is precedent for those years in which there was limited or no sockeye TAC. Table 2 provides an overview of run size, TAC, catch and exploitation rates for all years since paragraph 3e and 3g (Annex IV, Chapter 4, PSC 2023) have been in effect. The dominant cycle years have been excluded from this table given the substantial sockeye TAC available in those years. Of the 7 non-dominant cycle years since 2014, 6 had no international TAC by the end of the season. In those 6 years, the total sockeye exploitation rate including FIMs ranged from 3.82% to 18.66%, and the U.S. exploitation rate including FIMs ranged from 0.00% to 0.20%. In 2023, the U.S. and total exploitation rates including FIMS are 0.20% and 2.42%, respectively.

In past years without sockeye TAC but with pink-directed U.S. fisheries, Canada approved U.S. fishery proposals including the retention of sockeye in Treaty Tribal Ceremonial and Subsistence (C&S) fisheries, allowing for the non-commercial harvest of sockeye in Treaty Tribal fisheries for personal, ritual or community use.

- In 2017, pink-directed U.S. C&S fisheries with retention of sockeye occurred on August 23, 26, 28, and 31 as well as September 5, 2017 (Fraser River Panel Orders, 2017).
- In 2019, the first year of the Big Bar rockslide impact, the approved U.S. fisheries proposal for Treaty Tribal C&S fisheries directed at pink salmon allowed for the retention of those sockeye that were not expected to survive following their release. The fisheries proposal stated that "all efforts must be made to release sockeye alive" (Fraser River Panel Order, 20 August 2019). Non-C&S fisheries required non-retention of sockeye.

- In 2021, there was no sockeye TAC in-season and all pink salmon directed fisheries including C&S fisheries required non-retention. However, at the last in-season meeting, the parties adopted an increase in run size resulting in TAC.

In 2015 and 2016, U.S. sockeye catches were a result of available TAC at the time of the scheduling of the U.S. fisheries. The retention of sockeye for commercial use, by U.S. Treaty Tribal and All Citizen fisheries, was not allowed in any of the past years when there was no sockeye TAC.

Table 2: Overview of run size, available international TAC, available harvest, Washington, Canadian and test fishing catch, exploitation rate (ER, landed catch/run size) and exploitation rate including Fishery-Induced Mortalities (FIMs) of sockeye in pink-directed fisheries. The run size, TAC and available harvest are the estimates adopted at the last in-season Panel meeting, in accordance with Annex IV, Chapter 4 of the Treaty (PSC 2023). Note that, following common FRP practice, test fishing catch has been accounted for in the exploitation rate calculation while Canadian ESSR (Excess Salmon to Spawning Requirement) catch has not been included in either the Canadian catch or in the exploitation rates.

	2015	2016	2017	2019	2020	2021	2023
Sockeye salmon							
Run size	2,120,100	856,000	1,487,000	500,000	293,000	2,553,000	1,667,000
Available TAC	0	0	0	0	0	175,600	0
Available harvest	68,100	0	0	0	0	575,600	0
Washington Catch	46,200	1,700	1,500	470	0	20	2,370
FIMs	530	0	0	72	0	1,429	872
Canadian Catch	187,900	149,200	71,900	9,860	11,360	80,230	15,040
FIMs	0	0	1,760	2,216	1,665	5,831	5,440
Test Fishing Catch	38,000	8,800	13,830	6,410	4,610	17,970	16,660
Exploitation rate	12.83%	18.66%	5.86%	3.35%	5.45%	3.85%	2.04%
ER incl. FIMs	12.86%	18.66%	5.98%	3.82%	5.45%	4.13%	2.42%
Pink salmon							
Run size	5,781,300	NA	3,700,000	8,900,000	NA	8,000,000	10,521,000
Available TAC	662,200	NA	270,900	2,882,760	NA	1,995,000	4,274,730
Washington Catch	330,900	NA	102,200	233,290	NA	195,970	436,480
Canadian Catch	116,500	NA	37,200	300,260	NA	79,780	493,460
Test Fishing Catch	48,900	NA	17,700	17,240	NA	4,320	14,270
Exploitation rate	8.58%	NA	4.25%	6.19%	NA	3.50%	8.97%

The corresponding Canadian catches in years without sockeye TAC and without available harvest have shifted greatly over time. In 2016, Canada caught 149,000 sockeye in Chinook/sockeye directed FSC fisheries. More than 50% of these fish were caught and retained after August 5, when reduced in-season run size estimates eliminated harvestable surpluses across all sockeye management groups. No unauthorised sockeye retention or sockeye fisheries were reported in-season. In recent years, Canada moved towards non-retention of sockeye in Canadian fisheries when there is no harvestable surplus and as a result, FIMS increased to about 5,000 fish in 2021 and 2023.

Reports of unauthorised catch or unauthorised bycatch retention during years without harvestable surplus are a relatively recent phenomenon that has increased as sockeye catch and retention have become more restricted. In 2023, 14,338 sockeye were retained in Canada without authorisation from Canadian fisheries managers, comprising 95% of the total Canadian sockeye catch, in a year when there was no TAC or available harvest. It is unclear to what extent sockeye retention in U.S. fisheries encouraged the unauthorised sockeye retention in Canadian fisheries. In 2021, there was no authorised sockeye retention in U.S. fisheries and Canadian fishers retained 34,220 sockeye without authorisation.

In past years without TAC or available harvest, Canada approved U.S. fishery proposals including the use of drift gillnet gear in pink-directed fisheries despite using nets with mesh sizes suitable for targeting sockeye salmon. The closure of the Apex, when targeting pink salmon, first started in 2019. Initially, the Apex was only closed for All Citizen U.S. pink salmon fisheries. In 2021, the Apex was also closed to U.S. Treaty Tribal fisheries.

It is recognised that the changes in Treaty language interpretation over the years may have been caused by changes in perspectives and attitudes towards conservation. Changes in Treaty interpretations may cause disagreements unless both Parties align their change in interpretation.

Consequences of U.S. fisheries in 2023

U.S. catches and sockeye mortality

The U.S. fisheries resulted in both sockeye and pink salmon catches as well as sockeye FIMs following the release of sockeye caught in pink-directed fisheries (Table 3). Overall, the U.S.A. caught about 571,000 pink salmon of which 436,000 were Fraser pinks. This resulted in a U.S. Fraser River pink salmon exploitation rate of 4.2%. Close to 95% of Fraser River pink salmon were caught using purse seine gear, primarily in Treaty Tribal fisheries, while 4% were caught in All Citizen reef nets, and 1.4% were caught using gillnets.

Table 3: Overview of the result of U.S. fisheries directed at catching Fraser River pink salmon, in terms of total pink salmon catch, Fraser River pink salmon catch, the number of Fraser River sockeye caught and retained, FIMs associated with the release of sockeye in non-retention fisheries and the total fishing mortality associated with the U.S. fisheries. Catch reports and mortality estimates are provided for U.S. Treaty Tribal fisheries and All Citizen fisheries, split up by gear (GN = drift gillnet, PS = purse seine, and RN = reef net). Other fisheries may include unauthorised directed retention or unauthorised bycatch retention in fisheries directed at other species. (Catches and run size are subject to change with future updates. Values in this report are current as of December 1, 2023)

	Total pink catch	Fraser River pink catch	Fraser River sockeye		
			Catch	FIMS	Fishing mortality
U.S. Fisheries (Total)	**570,976**	**436,474**	**2,371**	**872**	**3,243**
Treaty Tribal Fisheries					
Areas 4B, 5, 6C – GN	0	0	0	0	0
Areas 6, 7, 7A – PS	436,789	330,519	2,172	851	3,023
Areas 6, 7, 7A – GN	360	250	39	0	39
All Citizen Fisheries					
Areas 7, 7A – PS	101,321	80,664	0	20	20
Areas 7, 7A – GN	7,381	5,987	0	0	0
Areas 7 – RN	25,134	19,054	0	1	1
Other Fisheries	0	0	160	0	160

Following the August 18 meeting, the U.S.A. caught and retained 2,371 Fraser sockeye in pink-directed Treaty Tribal C&S fisheries. The majority were caught using purse seine gear; 39 sockeye or 1.6% were caught with drift gillnets. An additional 160 sockeye, or 6% of the sockeye caught and retained, were retained in fisheries with regulated non-retention of sockeye. Starting after the August 22 FRP meeting, all U.S. fisheries stipulated non-retention of sockeye, resulting in an estimate of 872 FIMs following their release. Across the different U.S. fisheries, FIMs were largest for the Treaty Tribal fishery due to their

higher fishing effort. There were no sockeye FIMs associated with the All Citizen gillnet fisheries that caught close to 7,400 pink salmon.

The 2,371 sockeye caught and retained in pink-directed U.S. fisheries resulted in an incidental sockeye exploitation rate of 0.14% (Table 4). The U.S. catch contributed 7% to the total landed sockeye catch of 34,070. In comparison, Canada and the test fishery each contributed about 44-49% to the total landed sockeye catch (Table 2). Taking FIMs into account, the U.S. fisheries resulted in a U.S. exploitation rate of 0.19%, which combined with Canadian fisheries and test fishing resulted in a total exploitation rate of 2.42% (Table 2).

Table 4: Overview of the total incidental sockeye exploitation rate (exploit. rate, ER) across different sockeye management groups by U.S. fisheries or the total of all fisheries (U.S.A., Canada and test fisheries). Incidental exploitation rates in pink-directed fisheries represent incidental sockeye catch/run size or (catch + FIMs)/run size and exclude Canadian ESSR catch in directed sockeye fisheries. (Catches and run size are subject to change with future updates. Values in this report are current as of December 1, 2023).

	U.S. Fisheries		Total	
	Incidental exploit. rate	Incidental ER incl. FIMs	Incidental exploit. rate	Incidental ER Incl. FIMs
Sockeye salmon	0.14%	0.19%	2.04%	2.42%
Early Stuart	0.00%	0.00%	1.06%	1.16%
Early Summer	0.01%	0.01%	1.96%	2.10%
Summer	0.12%	0.16%	2.48%	2.89%
Late run	0.33%	0.47%	1.11%	1.66%

When evaluated by management group, the U.S. incidental exploitation rate was largest for Late run sockeye at 0.33%. Adding in the FIMs brought the total fishing induced mortality rate for Late run to 0.47%, compared to 0.16%, 0.01% and 0% for Summer, Early Summer and Early Stuart, respectively (Table 4). The exploitation rate including FIMs for all fisheries combined is largest for Summer-run sockeye (2.89%), followed by Early Summer (2.10%). Late run and Early Stuart have a total incidental and fishing induced mortality rate of 1.66% and 1.16%, respectively. These estimates are substantially below the Low Abundance Exploitation Rate (LAER) of 10% for the individual sockeye management groups.

As mentioned in a previous section, in addition to sockeye non-retention (effects reviewed above), Canada requested gear and area restrictions (exclusion of sockeye mesh sizes in gillnets and closure of the Apex in Area 7A). If the U.S.A. had not allowed the use of drift gillnet in pink-directed fisheries and had not allowed retention of sockeye in Treaty Tribal purse seine fisheries, the pink salmon catch would have been reduced by an estimated 1.43%, but the overall sockeye mortality would have been half of what is currently estimated (Table 5).

Data are not available to distinguish Apex catches from other Area 7A catches. Therefore, it is difficult to evaluate the impact of an Apex closure on sockeye exploitation rates. Area 7A as a whole, however, can be compared to other areas on the southern migration route. It was not possible to reject the hypothesis that sockeye proportions in Area 7A catches were equal to sockeye proportions in Area 20 on corresponding days. This could be due to low numbers of sockeye delaying in the Apex or due to low fishing effort in the Apex as indicated by in-season verbal reports.

Table 5: Overview of the potential impact of adjusting the U.S. fisheries to exclude the use of drift gillnet gear and not allow the retention of sockeye. The impact has been evaluated in absolute numbers and in percent difference relative to the observed pink and sockeye catch in addition to sockeye FIMS and total sockeye mortality. (Catches and run size are subject to changes with future updates. Values in this report are current as of December 1, 2023)

	Fraser pink	Fraser River sockeye		
	Catch	Catch	FIMs	Fishing mortality
Reported U.S. Fisheries	436,474	2,371	872	3,243
U.S. Fisheries assuming no gillnet or catch retention	430,237	160	1,415	1,575
% Difference	-1.43%	-93%	62%	-51%

Impact of U.S. fisheries on achieving FRP management objectives

The previous paragraphs document the consequences of the U.S. fisheries in terms of landed catch and total fishing mortality, but they do not provide an appropriate reference framework to judge if the incidental harvest of sockeye can be considered small but acceptable. In order to evaluate the impact of the U.S. fisheries, the following paragraphs review the extent to which these fisheries prevented the Panel from achieving its fisheries management objectives. In order of importance, these objectives are to: (1) achieve spawning escapement targets for Fraser River sockeye and pink salmon as determined by Canada; (2) achieve targets for international sharing of the TAC as defined in the Treaty; and (3) achieve domestic allocation goals within each country. The first objective is especially important when evaluating small but acceptable incidental sockeye harvest rates, but impacts on the other Panel objectives have also been documented as they may indicate to what extent accessing pink salmon TAC was prioritized over meeting sockeye escapement targets.

Achievement of sockeye and pink salmon spawning escapement

The Panel's first task is to achieve spawning escapement targets and for sockeye these need to be achieved by management group. Spawning ground data take time to be collected and processed, with estimates traditionally being available by the February Fraser River Panel meeting. In this report, the evaluation of the achievement of spawning ground escapement is based on the latest 2023 predictions of spawning escapement compared against spawning escapement targets (SET) (Table 6). The predicted spawning escapement is obtained by multiplying the run size by the total mortality rate including both fishing and natural mortality.

For 2023, the predicted spawning escapement was smaller than the SET across all sockeye management groups. With the exception of Summer-run sockeye, the natural mortality rates were predicted to be larger than the Total Allowable Mortalities (TAM) caps of 50% for all groups. As a result, it was not possible for any of these groups to reach SETs regardless of the run sizes which were 78%, 75% and 91% larger than forecast for Early Stuart, Early Summer run and Late run, respectively. For Summer run, the run size was 21% smaller than forecast. The total mortality for this group was 21%, but this was insufficient to reach the SET. Across sockeye management groups, the predicted escapements were expected to be below the SETs: 63%, 6%, 21% and 41% below target for Early Stuart, Early Summer, Summer run and Late run, respectively. While it is recognised that every sockeye counts when trying to reach SETs, sockeye fishing mortalities in 2023 had little impact on the ability to reach SETs compared to natural mortalities. If the U.S. fisheries had not retained sockeye and not used drift gillnet gear, it would be unlikely to have made a difference in terms of achieving SETs, e.g., the Late run escapement would be 41.02% below target instead

of 41.11%. For Fraser River pink salmon, the predicted escapement is estimated to be 60% larger than the target.

Table 6: Overview of the run size, spawning escapement target (SET), observed fishing mortality, including FIMs, predicted natural mortality associated with migration conditions in the Fraser River, predicted escapement and deviation from the target for the four sockeye management groups and pink salmon. Run size estimates are based on the final in-season reconstructed estimates of Mission hydroacoustic passage plus downstream catch.

	Run Size	SET	Fishing mortality rate incl. FIMs	Natural mortality rate	Predicted escapement	Deviation	%Dev.
Sockeye salmon	1,667,000	1,441,000	2%	33%	1,084,000	-357,000	-25%
Early Stuart	41,000	41,000	1%	63%	15,000	-26,000	-63%
Early Summers	332,000	166,000	2%	52%	156,000	-10,000	-6%
Summer	934,000	934,000	3%	19%	736,000	-198,000	-21%
Late run	360,000	300,000	2%	50%	177,000	-123,000	-41%
Pink salmon	10,521,000	6,000,000	9%	0%	9,577,000	3,577,000	60%

Achievement of Total Allowable Catch (TAC)

Given the low sockeye run sizes in 2023, there was no international TAC, and no harvestable surplus for Fraser River sockeye in-season (Table 7), and all sockeye management groups were managed in a LAER (Low Abundance Exploitation Rate). The TAC for Fraser River pink salmon was close to 4.3 million but access to this TAC was restricted due to a lack of sockeye TAC and harvestable surplus. The U.S. share of the pink salmon TAC was 1,101,000 fish (25.7% of the TAC), and the U.S.A. was able to catch about 436,000, 39.6% of their share of the TAC. Canada had an allowable harvest of close to 3.2 million pink salmon and was able to catch about 493,000 pinks, 15.5% of their share.

Table 7: Total Allowable Catch (TAC) and achievement of international catch shares for Fraser River sockeye and pink salmon in 2023. TAC calculations use the in-season estimates of run size, spawning escapement target and management adjustment at the time of the last adopted run size at an in-season Panel meeting (September 27), in accordance with the revised Annex IV, Chapter 4 of the Treaty agreed to January 2020.

	Sockeye	**Pink salmon**	
Total Allowable Catch	0	4,285,727	
United States			
Washington Share of TAC	0	1,101,432	25.7%
Washington Catch	2,211	436,482	10.2%
Other catch	159	0	
Deviation	-2,370	664,950	
Canada			
Canadian Share of TAC + U.S. Payback + AFE	0	3,184,296	
Canadian Catch (excluding ESSR & Other catch)	707	493,460	11.5%
Other catch	14,338	0	
Deviation (excluding ESSR)	-15,045	2,690,835	

Achievement of domestic allocation goals

The third priority of the Panel is to achieve domestic allocation goals as specified by the Parties. While there was no sockeye TAC, 100% of the U.S. sockeye catch was retained by U.S. Treaty Tribal fisheries for

ceremonial and subsistence purposes prior to the change in fishery regulations on August 22. For pink salmon, both Treaty Tribes and All Citizen fisheries caught less than their domestic share of the U.S. pink salmon TAC, 220,000 and 447,000, respectively.

Table 8: Achievement of domestic catch goals in Washington for Fraser River pink salmon in 2023.

	Actual Catch		Share of TAC		
	Pink salmon	%	Pink salmon	%	**Deviation**
Washington Total	434,800	100.0%	1,101,400	100.0%	-666,600
Treaty Tribal	330,700	76.1%	550,700	50.0%	-220,000
All Citizen	104,100	23.9%	550,700	50.0%	-446,600

In Canada, the majority of the sockeye catch (14,301 salmon) was obtained through unauthorised directed retention or unauthorised bycatch retention in fisheries directed at other species. An additional 1,322 and 707 sockeye were harvested as Escapement Surplus to Spawning Requirements (ESSR) and Canadian test fisheries (Albion), respectively. Of the 477,000 Fraser pink salmon caught by Canada, 443,000 were caught in Commercial Fisheries: 440,000 caught by the Area B purse seine fishery and 2,700 by the Area H Troll fishery. A total of 5,700 Fraser River pink salmon were harvested in Food, Social and Ceremonial (FSC) fisheries: 2,100 in marine FSC fisheries and 3,600 in Fraser River FSC fisheries.

Relevant information for in-season FRP fisheries decisions

In Canada's response to the letters of rationale for the U.S. fisheries (Appendix 4), concerns were identified regarding the process which led to the fisheries decisions adopted by the Panel during the August 18 and August 25 Fraser River Panel meetings. According to Canada, the decisions about small but acceptable incidental sockeye harvest rates in pink-directed fisheries should not be solely based on the expected fishing mortality in relationship to the run size but also include consideration about the fishing area, fishing gear and retention rules that would, to the extent practicable, avoid incurring unnecessary sockeye mortalities. For this report, Canada requested PSC staff to evaluate factors other than run size that are relevant to making sound fisheries management decisions, in particular factors that could be used in-season to inform the trade-off between incidental sockeye mortality and directed pink salmon harvest. Canada also requested PSC staff to make specific recommendations on the use of these additional factors. The following paragraphs respond to this request.

Factors relevant to sound fisheries management decisions

Fishery managers have a variety of tools at their disposal to control the magnitude of mortality caused by salmon fishing. These tools include spatial and temporal openings, restrictions to fishing gear, and periods of non-retention for incidentally caught species. The effectiveness and appropriateness of these tools may vary depending on the abundance and the behaviour of target and non-target species, the available data and the need to balance catch, or total mortality, against other fisheries objectives. Some factors may change throughout the season, such as the proportions and abundance of fish available in a particular area. Others remain fixed, such as the expected mortality of salmon encountering and being released from a particular gear. In combination, the factors described below reflect important considerations for fisheries managers trying to evaluate the impact of a given fisheries opening.

In short, the factors discussed below include the relative abundance of the different species or management groups, the fishing effort and catchability of the fish by the gear, gear selectivity, mortality

rates following the release of fish from the gear and the sockeye mortality in relation to the combined sockeye and pink salmon mortality.

Stock or species composition in the proposed fishing area

Even without considering gear selectivity, relative abundances of different management groups or different species will have an impact on their probability to be intercepted by fisheries. The need to account for the relative abundance of different management groups or species is specified in the Treaty language (Annex IV, Chapter 4, paragraphs 3e and 3g, PSC 2023). These paragraphs indicate fisheries should be targeting management groups or species with the largest TAC, but they also indicate that impacts on management groups with little or no TAC should be minimized.

It is not uncommon for Canada to implement "rolling window closures" to provide additional protection to certain salmon species or stocks as they migrate through marine approach areas. Species and stock composition in a given area can vary widely over the course of the season depending on the migration timing and diversion rate associated with a particular group of salmon.

In general, the overall abundance and peak migration timing of sockeye management groups varies between Johnstone Strait and Juan de Fuca Strait and is influenced by the increasing diversion through Johnstone Strait throughout the season (Hague and Michielsens 2023). As a result, with the exception of the earliest timed stocks, peak timing in Johnstone Strait typically averages 5-days later than in Juan de Fuca Strait (Hague and Michielsens 2023). Because the pink salmon diversion rate does not follow the same pattern as sockeye, this means the relative species composition between the northern and southern approach routes can differ substantially over time. These differences were exacerbated in 2023 due to the high northern diversion rate for Fraser sockeye compared to pink salmon. Table 9 compares the proportion of total sockeye and Late-run sockeye in different fishing areas at the time of peak pink salmon migration through each area. Overall, the relative abundance of Fraser River sockeye (20%) and Late run sockeye (6.7%), specifically, was higher in Johnstone Strait (Area 12) than in any other area due to high sockeye diversion rate (93%) through the area at the time of peak pink migration. In comparison, Late run sockeye only comprised 2.7% of the combined Fraser River sockeye and pink salmon abundance in the Juan de Fuca Strait (Area 20) during the window of peak Fraser pink migration. Abundances of Late-run sockeye and pink salmon are expected to be most concentrated in the Strait of Georgia (Area 29) due to delay behaviour demonstrated by both populations. However, the proportion of delaying Late-run stocks compared to pink salmon in the Strait of Georgia depends on both the abundance and extent of delay exhibited by both species in a given year. Assuming both sockeye and pink salmon are distributed homogeneously throughout the area (see next section on availability), the proportion of sockeye salmon was substantially lower in the Strait of Georgia (3.6%) compared to other marine fishing areas (14 to 20%). Of the salmon present, the proportion of Late run sockeye stocks that delay their upstream migration, however, was substantially higher in the Strait of Georgia (2.4%) compared to Juan de Fuca Strait (0.24%). While no direct observations exist regarding the relative abundance of Late run in the Apex of U.S. Area 7, in 2023 the proportion of <u>total</u> Late run in Juan de Fuca Strait and the Strait of Georgia were similar at 2.7%, but the proportion of <u>delaying</u> Late run was 10 times higher in the Strait of Georgia than in Juan de Fuca Strait. Compared to the marine area, differences in migration timing between sockeye and pink salmon, and between delaying Late run stocks and pink salmon, are more pronounced in the Fraser River.

Table 9: Overview of the relative abundance of sockeye and Late-run sockeye at the time of peak salmon migration at different locations along their migration route in 2023. The total relative abundance estimates are based on the estimated proportions of sockeye or Late-run sockeye for the 5 days around the peak pink salmon migration date in that area. Total salmon refers to the Fraser River sockeye and pink salmon, while delaying Late run sockeye refers to Late Shuswap, Portage, Weaver and Cultus stocks, excluding the Birkenhead group of Late run stocks that do not delay their upstream migration into the Fraser River.

	Area-specific peak pink salmon migration date	Relative sockeye versus pink salmon abundance		
		Sockeye / Total salmon	Late run / Total salmon	Delaying Late run / Total salmon
Johnstone Strait (Area 12)	August 22	19.86%	6.65%	2.56%
Juan de Fuca Strait (Area 20)	August 14	13.78%	2.68%	0.24%
Strait of Georgia (Area 29)	September 1	3.59%	2.66%	2.38%
Fraser River (Mission)	September 8	1.21%	0.64%	0.49%

As a factor to consider for fisheries management, the relative abundance is useful as it is independent of fishing gear and other, more subjective factors related to the ability to target pink salmon versus sockeye salmon. While the results presented in Table 9 are very specific to 2023, there are some generic statements that can be made that are valid across years and that could help fisheries management decisions:

- Across various fishing locations, the relative abundance of sockeye during peak pink salmon migration is smallest in the Fraser River.
- In marine areas, sockeye to total salmon proportions tend to be larger in Johnstone Strait versus Juan de Fuca Strait during the period of peak Fraser pink salmon migration due to the increasing sockeye diversion rates as the season progresses.
- In years like 2023, when the abundance of delaying Late-run sockeye is low (non-dominant years) and makes up a smaller proportion of the Late run (40%), the proportions of Late run sockeye in the Strait of Georgia may be similar to the proportion in Juan de Fuca Strait, but the proportion of delaying sockeye may be substantially larger in the Strait of Georgia.
- In years like 2023, the Apex may have a similar proportion of Late run compared to Juan de Fuca Strait due to their geographical proximity.

Fishing effort

Fishing effort relates to the amount of fishing activity over a given period of time. The U.S. fishing effort for Fraser River sockeye and pink salmon is expressed in terms of the number of participating vessels fishing daily or for part of a day, and is used in the harvest rate equations to predict U.S. catches as well as FIMs. Unlike Canada, which can adjust fishing effort for commercial fisheries through ITQ restrictions, the main management lever in U.S. fishing effort is to restrict the length of fisheries openings. In a year like 2023, when incentives to participate in pink-directed fisheries are lower due to low pink salmon prices, the number of vessels participating in U.S. fisheries might not be an accurate reflection of actual fishing effort, causing PSC staff to overestimate the impact of U.S. fisheries in terms of catches and FIMs.

Catchability

Catchability depends on two components: availability of fish to the fishing gear and the efficiency of the gear in capturing fish. As factors that are relevant to sound fisheries management decisions, this report discusses the two components separately.

Availability to the fishing gear accounts for the fact that salmon are not necessarily homogeneously distributed throughout an area. For example, in the Strait of Georgia, delaying sockeye and pink salmon tend to be concentrated along the eastern fishing boundary. This statement is based on past assessments of relative sockeye abundance in the Gulf (Lagasse et al. 2020) and observed locations of fishing vessels in the area. Availability to the fishing gear also depends on depth of the fish swimming through the fishing area. The depth at which the fish are migrating can be both a function of environmental conditions as well as differences between stocks and species. For example, gillnet gear may have a harder time accessing both Late-run sockeye (Hague and Michielsens 2023) and pink salmon if these fish are migrating lower in the water column compared to Early Summer-run sockeye. Catchability in gillnet test fisheries tends to decrease as the season progresses, eventually reaching a point where catchability is so low that the test fisheries no longer provide useful information for in-season management (Michielsens and Martens 2022). Recent reconstruction analyses conducted by PSC Secretariat staff demonstrated that the relative abundance of Late-run stocks excluding Birkenhead in gillnet catch is lower than expected based on their actual abundance, confirming a stock-specific explanation for the seasonal trends in catchability previously observed (Hague and Michielsens 2023).

In the river, there is substantial evidence of differences in availability of the different species depending on location within the river. For example, pink salmon that migrate closer to shore will not be as readily caught by the driftnet fishery as sockeye, who tend to migrate further offshore where the driftnet is deployed. Similarly, pink salmon are more readily caught by gear that can be deployed close to the riverbank, such as a fish wheel or beach seine gear.

Availability of different salmon species to the gear is a factor that is more difficult to consider on its own when making fisheries management decisions, especially given limited fishery-independent information on fish behaviour. Instead, availability is usually considered a factor that influences other factors such as encounter rates or gear selectivity.

Encounter rates relate to the proportion of the vulnerable population that makes contact with the gear and is either caught and retained or released. Encounter rates are similar to harvest rates, except that they do not imply all the salmon caught will be retained. Encounter rates depend in large part on the fishing gear used, the fishing areas and the abundance and availability of fish in the area. Test fishing expansion lines can provide an indication of the relative difference in encounter rates between species for different gears or in different areas. Overall, the sockeye encounter rates of purse seine gear are larger than for gillnet gear, or the efficiency in capturing sockeye is greater for purse seine than gillnet gear. In the relatively narrow Johnstone Strait, the sockeye purse seine encounter rate is greater than in Juan de Fuca Strait, because sockeye are more concentrated. Similarly, the encounter rate using drift gillnets in the river is greater than the encounter rate when using drift gillnets in marine areas.

Encounter rate is an important factor to consider for fisheries management. In-season evaluations of encounter rates, however, are not straightforward given their large variability. With limited commercial fisheries in recent years, test fisheries are the primary source of information on encounter rates in-season. These may differ from encounter rates of the fisheries proposed by either Party, primarily due to the differences in abundance and availability of fish in the proposed fishing area compared to the test fishing location. In addition, because the objective of test fishing is to get reliable estimates of salmon abundance rather than to maximize catch, the behaviour of the test fishers differs substantially from other fishers. For these reasons, historical harvest rates per vessel are relied upon when predicting encounter rates for proposed U.S. and Canadian fisheries. In 2023, given the restrictions in sockeye retention, low pink salmon

prices and the lack of participating tender boats to offload catches, accurate predictions of the U.S. encounter rates were hampered by uncertainty regarding the amount of likely participation.

Gear selectivity

Gear selectivity relates to the ability of a gear type to capture certain groups of the salmon population, whether by species or by sockeye management groups. The probability of capture by a particular fishing gear will depend on traits of both the gear and the salmon population. The use of selective gears may allow for the harvest of a surplus target species or population while minimizing the impact on a species or population of conservation concern. Within Canada's IFMP, gillnet gear is considered a non-selective fishing gear (DFO 2023) regardless of potential modifications that can be made (e.g., in terms of mesh size, net material and fish handling procedures). The non-selective nature of gillnet gear is illustrated by catch data collected from the multi-panel net at Qualark (Table 10). The Qualark test fishery has been chosen for this example as the test fishery covers the entire area where the salmon migrate, while test fishing catches at Mission are only representative of the salmon migrating offshore. Even when a smaller mesh size is used to target pink salmon, the net will still also catch sockeye as well as Chinook salmon (Table 10). To avoid or limit sockeye bycatch in pink-directed fisheries, it can be better to use gear that is more selective than gillnets. The selective gear mentioned in the IFMP includes purse seine, modified shallow seine, fish trap, partial weir, beach seine, dip net and fish wheel gear (DFO 2023).

Table 10: Relative proportion of the catch of different species caught in different panels of the multi-panel net used at Qualark to derive species composition. These estimates are based on historical catch data by mesh size from 2008 to 2020. Only 3 of the available mesh sizes are reported here.

	4-inch net	5.25-inch net	8-inch net	Total
Chinook jacks	92%	5%	3%	100%
Pink salmon	40%	39%	21%	100%
Sockeye	64%	26%	10%	100%
Adult Chinook	33%	29%	38%	100%

Fraser River pink salmon return in substantial numbers only in odd numbered years. In years like 2023, the use of selective fishing gear can be an important fisheries management tool to maximize pink salmon catch while minimising the impacts on sockeye salmon. However, given that it requires time and money to replace fishing gear, a shift towards more selective fishing gear is more feasible as part of a longer-term fisheries management strategy rather than an in-season management approach. Further, whereas selective fishing gear may facilitate reduced sockeye impacts when targeting pink salmon, the same gear will be less effective at targeting abundant sockeye management groups while minimizing catches of management groups with limited or no TAC.

Release mortality rates

Fishery-induced mortality (FIM) or release mortality occurs due to stress or injuries sustained during capture and handling. The shape, size and material of the mesh used in a fishing net can have a substantial impact on the type and extent of injury or stress a salmon experiences (Patterson et al. 2017). Fishery-induced sockeye mortality may occur within pink-directed fisheries requiring non-retention of sockeye. FIMs are estimated based on the percent of sockeye within the catch and a release mortality rate associated with the relevant gear type (Table 11). It should be acknowledged, however, that accurate and objective estimates of release mortality are difficult to obtain and only available from individual studies that may underestimate the mortality given their focus on the period immediately following the release (DFO 2016). Handling and revival techniques may be employed to reduce release mortality rates and

increase the probability of survival (Patterson et al. 2017). On the other hand, additional factors such as high water temperatures and injury may decrease the probability of survival relative to standard rates (DFO 2016).

Table 11: Overview of sockeye release mortality rates associated with different fishing gear.

Fishing gear	Release mortality
Reef net	0.5%
Gulf Troll	10%
Purse seine	25%
Drift gillnet	60%

Gear specific estimates of release mortality are primarily useful as a fisheries management tool when calculating the mortality associated with non-retention of bycatch (see next section).

Sockeye mortality rate

The sockeye mortality rate in a non-retention fishery is calculated by multiplying the sockeye encounter rate by the sockeye release mortality rate. Canada currently uses a 1% Mortality Rule applied to sockeye salmon to inform decisions regarding the spatial and temporal openings of marine and non-tidal commercial, economic and demonstration fisheries directed at pink salmon (DFO 2023). This rule stipulates that total sockeye mortality should be less than 1% of the total salmon caught in pink-directed fisheries. The 1% Mortality Rule allows implementation of a trade-off between sockeye encounter rates and release mortality rates. For example, when using gillnet gear with a release mortality of 60%, the sockeye encounter rate needs to be below 1.67% to meet the 1% Mortality Rule so that a pink-directed fishery can be scheduled. When using purse seine gear (release mortality of 25%), pink-directed fisheries could be scheduled sooner, i.e., when the sockeye encounter rate is below 4%. If all the U.S. catch in 2023 had been caught using purse seine, the maximum sockeye mortality associated with the U.S. pink salmon catch of 436,000 fish would be 4,531 sockeye. This estimate is larger than the post-season estimate of the sockeye mortality (3,242 fish). From this perspective, the aggregate U.S. pink-directed fisheries in 2023 satisfied the 1% Mortality Rule.

Focusing only on U.S. pink-directed gillnet catches (6,237 Fraser River pink salmon, Table 3), the maximum allowable sockeye mortality (under the 1% Mortality Rule) associated with this gillnet fishery is 63 sockeye, which is larger than the 39 sockeye reported as FIMs. In contrast, when evaluating Treaty Tribal fisheries on their own, the sockeye mortality would exceed the threshold of 1% of the total salmon caught.

Overall, sockeye mortality rates are useful for evaluating the impact of pink-directed fisheries on sockeye stocks. Fisheries management based on sockeye mortality rates such as the 1% Mortality Rule, however, may prioritise access to pink salmon TAC over conservation concerns for sockeye. This is because the maximum sockeye mortality increases as available pink salmon catch or TAC increases. Implementing the 1% Mortality rule to the full pink salmon TAC available on August 18, for example, would have resulted in pink-directed fisheries allowing a maximum sockeye mortality of 29,000 sockeye. In addition to the 1% mortality rule not necessarily prioritising sockeye conservation concerns, there is considerable uncertainty associated with predictions of pink salmon catches used for the calculation of the 1% Mortality Rule, which is caused by the imprecision and variability in estimates of the vulnerable pink salmon abundance and catchability as well as errors in assumptions about the number of participating vessels. In 2023, pink catch predictions often exceeded observed landings as a result. Predictions of sockeye mortality and catch are

generally more accurate given the higher accuracy and precision in terms of the abundance and catchability.

Recommendations

In its request for this report (Appendix 5), Canada identified concerns regarding the process that led to fishery decisions adopted by the U.S.A. during the 2023 season and requested this report to include specific recommendations on what information could be used in-season to inform the trade-off between incidental mortality and directed harvest. Recommendations were also requested regarding other factors relevant to sound fisheries management decisions in relation to addressing conservation concerns and achieving escapement objectives (Appendix 4 and 5).

Below is a list of recommendations based on Canada's request. These recommendations, however, will require further discussion with both the Panel and Technical Committee in terms of whether and how they should be implemented. This is not an exhaustive list as the Panel and Technical Committee may have additional recommendations following the 2023 season.

- While the list of potential factors relevant to sound fisheries management decisions mentioned in this report is far from exhaustive, factors discussed in the paragraphs above provide a general sense of the complexity involved when making in-season bilateral fisheries management decisions. They all are important factors, but when it comes to evaluating fisheries proposals, the bottom line remains the resulting incidental sockeye fishing mortality. Not only do fishing mortality estimates combine and summarise the results of the various factors that could be considered when planning fisheries, they also allow for a more streamlined in-season process to evaluate fisheries proposals. Assuming an appropriate incidental fishing mortality rate limit is selected, any fishery proposal could be evaluated based on the predicted incidental sockeye fishing mortality rate compared to the limit. When predicted fishing mortality rates exceed the limit, it would be up to the individual Party to decide how to adjust its fisheries proposal to remain within the limit, for example by not allowing the retention of sockeye or by delaying the use of non-selective fishing gear to a later date. As directed by the IFMP, the total incidental sockeye fishing mortality rate limit would be substantially lower than the LAER, but unlike the LAER could be used as a target when planning fisheries with a small but acceptable incidental harvest of comigrating sockeye.

    - **Recommendation 1**: Consider the use of small but acceptable incidental fishing mortality rate limits for Fraser River sockeye salmon, calculated by dividing the landed catch and fishery-induced mortality by the total sockeye run size. This would allow both Parties to adjust their fisheries proposals using the various factors that determine sound fisheries management practices to keep the incidental fishing mortality below the limit but allows some autonomy to the individual Parties on how to achieve this.

- Both countries agree that the definition of "small but acceptable" is context specific. In 2023, both Parties primarily evaluated the incidental sockeye harvest in terms of expected sockeye catch numbers or FIMs depending on retention being allowed or not. Evaluating the expected fishing mortality in relation to the run size, and not in relation to the abundance in the fishing area, automatically facilitates the adjustment of the incidental fishing mortality to in-season changes to run size. For example, the pre-season sockeye run size was 1,564,000, and in the base case planning scenario, the incidental fishing mortality rate associated with a small but acceptable incidental sockeye harvest rate was agreed to be 0.40% or 6,300 sockeye. On August 18, the in-season run size estimate was 1,339,000. Assuming the 0.40% would be used to define the small

but acceptable rate, the total fishing mortality limit would be automatically adjusted downward to 5,356 sockeye.

    - **Recommendation 2**: Evaluate the criteria of small but acceptable incidental sockeye harvest rate as fishing mortality rate relative to the sockeye run size instead of absolute sockeye numbers caught by proposed pink-directed fisheries.

- The identification of a small but acceptable limit of incidental sockeye fishing mortality when there is no harvestable surplus would be preferable to evaluating the trade-off between incidental sockeye fishing mortality and directed harvest of pink salmon. The latter does not prioritise conservation concerns, as it may allow substantial impacts on the sockeye management groups as long as the payoff in terms of pink-directed harvest is large enough. Canada's IFMP (DFO 2023) currently uses the 1% sockeye Mortality Rule to guide the harvest of pink salmon in Canadian commercial, economic and demonstration fisheries. Expanding the application of the 1% Mortality Rule to guide international fisheries management decision may result in prioritizing access to pink salmon TAC over sockeye conservation concerns. Instead, it would be better to assess the impact of the incidental fishing mortality on sockeye stocks and identify a level that would support conservation. Once an appropriate level of incidental fishing morality is identified, this estimate can be used in-season to objectively evaluate fishery proposals.

    - **Recommendation 3**: When there is no international TAC or harvestable surplus, small but acceptable levels of incidental fishing mortality for sockeye should not be based on the trade-off with pink salmon harvest.

- Selection of a small but acceptable incidental sockeye fishing mortality rate limit could be better negotiated pre-season compared to in-season. Pre-season, the Panel and Technical Committee evaluate different fisheries plans under different scenarios of run size, timing and diversion rate. In 2023, both Parties agreed to a pre-season fisheries plan under the base case scenario of the p50 forecast for both species but with delayed Treaty Tribal fisheries and reduced fishing effort. The incidental sockeye fishing mortality including FIMs for U.S. fisheries in this scenario was 0.40% or 6,300 sockeye (5,300 incidental sockeye catch and 1,000 sockeye FIMs). In this case, the 0.40% could be regarded as the small but acceptable incidental sockeye fishing mortality rate limit including FIMs. If using a 0.40% limit in-season for the evaluation of the fishery proposal on August 18, the fisheries proposal would have been rejected as the predicted incidental sockeye fishing mortality rate of 0.44% (Table A3) was larger than the small but acceptable limit assumed from the pre-season plan. Implementation of this limit could have resulted in the U.S.A adjusting its proposals, taking into account all the above-mentioned factors to reduce the incidental sockeye fishing mortality below the limit. This could have been achieved in a variety of ways. For example, allowing sockeye retention in gillnets only and non-retention in purse seine fisheries would have reduced the incidental sockeye fishing mortality to 0.23%. Alternatively, delaying the opening of the Treaty Tribal gillnet fishery, but maintaining sockeye retention in Treaty Tribal purse seine fisheries would have reduced the incidental sockeye fishing mortality to 0.28%. All U.S. fisheries as proposed after August 18 in 2023 would have been accepted, given non-retention of sockeye, because the cumulative incidental sockeye fishing mortality rate including FIMs was lower than the assumed 0.40% limit.

- **Recommendation 4**: Consider if a fixed small but acceptable fishing mortality rate limit could be identified pre-season based on the Panel adopted pre-season fisheries plan and implemented throughout the season.

- Current Treaty language is vague in describing the incidental harvest rate of sockeye management groups needing to be small but acceptable. In DFO's guidance on implementation of the policy on managing bycatch (DFO 2013a), it is stated that management measures to address bycatch should be, among others, clear and measurable. The Treaty relies on Canada's preseason escapement plan as published within the IFMP to define the harvest control rule for Fraser River sockeye and pink salmon (DFO 2023). In the IFMP, the LAERs are identified as low incidental exploitation rates to allow bycatch in fisheries directed at co-migrating stock or species. The objective of the LAER is to allow as many fish as possible to reach the spawning grounds while allowing some limited incidental mortality, and in some cases some limited directed harvest (DFO 2023). The LAERs should not be considered targets but rather the maximum exploitation rate permissible when there is no harvestable surplus. Overall, LAERs provide limited guidance on what should be considered small but acceptable.

    - **Recommendation 5**: Consider the use of well-defined, objective fisheries management criteria, with definitions agreed upon by both Parties.

- According to Canada, "to the extent practicable" is an important factor when considering fisheries proposals (Appendix 4). It is Canada's view that fisheries management choices on area, gear and sockeye retention, to the extent practicable, should prioritise meeting sockeye escapement targets, not achieving pink salmon TAC. The extent "practicable," however, is subjective and views between Canada and the U.S.A. may differ. For example, according to Canada it is practicable not to retain sockeye in pink-directed fisheries, while according to the U.S.A. this is not practicable given that "U.S. tribes also have cultural beliefs, enshrined in their respective laws and fishing regulations that require their fishers to retain all catch, including bycatch, for sampling purposes and to prevent wastage" (Appendices 2 and 3). Similarly, Canada requested the U.S.A. to modify the gear used in its fisheries proposal, from gillnet gear to purse seine nets. The U.S.A. does not view these requests as practicable given that "many of the U.S tribal fisheries operating in Panel-controlled waters primarily or exclusively use gillnet gear" (Appendix 2).

    - **Recommendation 6**: Avoid the use of subjective fisheries management criteria such as "to the extent practicable".

- In-season run size is not the only criterion with which the Panel may define the level of small but acceptable incidental harvest. It could be argued that the identification of harvestable surplus and available TAC are additional criteria that provide context to what is considered small but acceptable. Similar to the Total Allowable Mortality (TAM) being adjusted depending on run size, the incidental sockeye harvest rate that is considered small but acceptable can be adjusted depending on harvestable surplus and TAC. Environmental conditions and predicted en-route losses during migration to the spawning grounds is another important consideration when defining small but acceptable incidental harvest. However, the in-season harvest control rule to derive harvestable surplus and TAC already accounts for changes in natural mortality, and therefore it can be argued that there is no need to add environmental conditions as an explicit additional criterion. Table 12 provides an overview of 4 different contextual situations. For harvestable surplus, a distinction has been made between the situation when there is harvestable surplus for Summer

run and when harvestable surplus is only available for Early Summer run. When the latter occurs, it will be easier to access the harvestable surplus in sockeye-directed fisheries rather than through the retention of sockeye salmon in pink-directed fisheries. Late run sockeye are not mentioned in this table as it is assumed that, on non-dominant years, the predicted mortality associated with the Late run management adjustment is larger than the TAM cap of 50%, making it impossible to have any harvestable surplus or available TAC.

Table 12: Overview of different contextual situations that may impact what level of incidental U.S. sockeye harvest rate or fishing mortality rate would be considered small but acceptable.

	Contextual situations in which "small but acceptable" may have a different meaning
1	Available TAC for one or more sockeye management groups
2	Harvestable surplus for Summer run but no TAC, meaning Canadian FSC fisheries may target Summer run in sockeye directed fisheries or retain sockeye in pink-directed fisheries
3	Harvestable surplus for Early Summer run only but no TAC, meaning Canadian FSC fisheries may target Early Summer run in sockeye directed fisheries
4	No TAC and no harvestable surplus across all sockeye management groups, meaning only incidental harvest of sockeye in pink-directed fisheries can occur

  - **Recommendation 7**: Identify the different contextual situations which may require a different assessment of incidental harvest rate or fishing mortality rate to be considered small but acceptable.

- Once the different contextual situations are identified, it is important to include them among the alternative scenarios during pre-season modelling. Similar to the base case scenario, it will be important that there is bilateral agreement on the U.S. fisheries scheduled and if the associated incidental sockeye fishing mortality rate can be considered small but acceptable.

  - **Recommendation 8**: The alternative planning model scenarios should evaluate alternative contexts for the application of small but acceptable criteria, e.g., sockeye TAC, no sockeye TAC but harvestable surplus of Summer run or of Early Summer run only, or no sockeye harvestable surplus for any management group.

- The impact of fishing mortality on a stock remains the same regardless of whether the salmon was retained or died following release from the fishing gear. In 2023 Canada raised concerns about the retention of sockeye when there was no TAC. DFO's policy on managing bycatch (DFO 2013b) indicates that sustainable harvesting means that the impact of all fishing activities, in terms of the cumulative fishing mortality, should not exceed sustainable levels, regardless of whether catch is retained or released. In its guidance on the implementation of the policy, DFO also lists "allowing landing of non-directed catch" as a management measure that can be used to manage bycatch, noting it has been successfully used in the integrated groundfish fishery (DFO 2013a). The Code of Conduct of Responsible Fisheries (FAO 1995) indicates that, while it is important to minimize the catch of non-target species, waste and discards should also be minimized.

  - **Recommendation 9**: Consider allowing the retention of sockeye in pink-directed fisheries even when there is no harvestable surplus or available TAC for any of the sockeye management groups, i.e., clarify the term incidental harvest in the Treaty, Annex IV, Chapter 4, paragraph 3e and 3g (PSC 2023).

- While requiring the non-retention of bycatch may seem like a fisheries management approach that promotes conservation, the impacts this fisheries management strategy may have on the unauthorised retention of bycatch should be considered. For example, in 2023, Canada did not allow the retention of sockeye in any of its fisheries directed at other species, and 14,301 sockeye were retained in unauthorised bycatch in fisheries directed at other species or caught in unauthorised fisheries directed at sockeye. Allowing both countries a limited amount of sockeye bycatch to be retained, below an identified incidental sockeye fishing mortality rate limit, is one of several approaches that could be considered. The cost of allowing some retention, in this case and others with fixed incidental mortality rate limits, would be some forgone directed harvest of pink salmon that could be accessed if more sockeye would be released instead of retained.

    - **Recommendation 10**: Evaluate methods to reduce unauthorised bycatch retention of sockeye in fisheries directed at other species including pink salmon and Chinook, including the authorized retention of sockeye bycatch, assuming the incidental fishing mortality rate remains below the identified limit.

- As annual sockeye returns have declined, Fishery-Induced Mortalities have become increasingly important. Looking at years without TAC or harvestable surplus (Table 2), there has been a shift from substantial catch retention and limited to no reported FIMs in 2016 and 2017 to years like 2023, when FIMs contributed substantially to the total fishing mortality, especially when unauthorised catch retention was excluded from the calculation. The reporting of FIMs has also evolved over the years, with reports only being received post-season in earlier years, whereas in-season predictions and reports of FIMs have been important for making fisheries management decisions in recent years. It is therefore important to assess how the reliability and accuracy of these estimates can be improved.

    - **Recommendation 11**: Implement measures to evaluate and improve the reliability and accuracy of reported FIM estimates.

- Within the Fraser River Panel process, FIMs are excluded from total catch estimates and are not counted against the TAC. FIMs are included in the estimates of the exploitation rate, as this indicator is compared against the Low Abundance Exploitation Rate (LAER). FIMs are not reported explicitly within the in-season FRP meeting packages.

    - **Recommendation 12**: FIMs should be documented more explicitly in catch reports and the TAC table.

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Treaty Between the Government of Canada and the Government of the United States of America Concerning Pacific Salmon, as amended through June 2023. (https://www.psc.org/publications/pacific-salmon-treaty/)

Appendix 1: Pre-season fishing plans and in-season U.S. fisheries decisions

This appendix contains the necessary background information extracted from Fraser River panel minutes regarding the 2023 season; more specifically a description of the pre-season planning and in-season FRP meetings during which the proposed U.S. fisheries were evaluated.

Pre-season fishing plans

The median pre-season forecasts for 2023 totaled 1.6 million sockeye and 6.1 million pink salmon. For sockeye, half of the forecasted abundance was expected to be age-5 sockeye given the record low return in the 2019 brood year and the negative impact of the 2019 Big Bar rockslide, which prevented part of the salmon run to migrate past the site. As a result, only 305,000 sockeye made it to the spawning ground in 2019. For pink salmon, the 2021 brood year run size had been 8.1 million but pre-season expectations had been moderated due to the widespread flooding in the fall of 2021 and low fry outmigration in 2022.

Based on the median pre-season sockeye forecasts, there was no Total Allowable Catch (TAC), or harvestable surplus available for any of the sockeye management groups. For pink salmon, based on pre-season modelling, both Canada and the U.S.A. expected to be able to catch close to their full pink salmon TAC in pink-directed fisheries, 575,600 and 199,100 pink salmon respectively. Given the overlap in migration between sockeye and pink salmon, both countries were however expecting some bycatch of sockeye. Within the Treaty it is recognised that pink-directed fisheries may result in a small but acceptable rate of incidental harvest on one or more overlapping sockeye management groups with little or no TAC. The Treaty also stipulates that, to the extent practical, the impacts on sockeye management groups with little or no TAC should be minimized while trying to achieve the available TAC for pink salmon. Depending on the relative differences in run size, timing and diversion rate between the sockeye and pink salmon run and depending on the timing, type and length of planned fisheries as well as the sockeye retention policy, the incidental harvest rate will vary. The PSC staff report following the 2022 season recommended that the base case fisheries planning model adopted by the Panel should include fisheries that meet both countries' criteria of small but acceptable incidental harvest rates for management groups with limited or no TAC. In the bilateral response to the 2022 report, both Parties agreed with this recommendation and planned to develop agreed upon model runs at the p50 and another level, at a minimum and more if required.

Pre-season, the Panel explored six different fisheries planning model scenarios (Table A1): (1) median (p50) forecast levels for both species, (2) p75 forecast level for both species, (3) median forecast level for sockeye with 10.5 million pink salmon run size, (4) median forecast level for both species with early pink migration timing, (5) median forecast level for both species with sockeye non-retention in Treaty Tribal fisheries, and (6) median forecast level for both species with increased sockeye migration through Johnstone Strait instead of Juan de Fuca Strait. Sockeye TAC was only available in the p75 forecast level scenario. The scenario with 10.5 million pink salmon and the scenario with early pink timing made it more difficult to catch the total TAC due to sockeye constraints. In the non-retention scenario, the sockeye mortality associated with U.S. fisheries decreased by approximately 25%. Both countries achieved their TAC in all scenarios with the exception of Canada who reached 65% of the pink TAC at the p75 forecast scenario (2) due to sockeye constraints.

Under the different scenarios that assumed a median sockeye forecast, the U.S. catch of sockeye ranged from zero sockeye assuming sockeye non-retention in Treaty Tribal fisheries to 16,800 assuming the pink salmon run size would be 10.5 million (Table 1). Including FIMs, the total sockeye mortality under the different median sockeye forecast scenarios ranged from 4,800 sockeye both for the non-retention scenario and the scenario assuming higher northern diversion to 20,200 assuming the pink salmon run size

would be 10.5 million. Canada noted concerns about the plan to retain sockeye in Treaty Tribal fisheries when there was no TAC and the use of gillnet with 5-inch mesh that would target sockeye. The U.S. Treaty Tribal representatives expressed concern regarding non-retention of sockeye in pink salmon fisheries as it goes against traditional values to throw dead fish away. Canadian First Nations representatives stated that they equally do not want to see fish wasted but have to do so under the imposed fisheries regulations.

Table A1: Overview of the pre-season prediction of the impact of U.S. fisheries on sockeye salmon: the predicted incidental sockeye catch and associated harvest rates, and the predicted total sockeye mortality and mortality rates based on assumed pre-season sockeye run size estimates under different pre-season fisheries planning scenarios.

	Incidental sockeye catch	Incidental sockeye harvest rate	Total sockeye mortality	Sockeye mortality rate
Base case scenario: median (p50) forecast for both species but with delayed Treaty Tribal fishery with reduced fishing effort	5,300	0.34%	6,300	0.40%
(1) median (p50) forecast for both species	9,500	0.61%	10,800	0.69%
(2) p75 forecast level for both species	95,600	3.00%	95,600	3.00%
(3) p50 forecast for sockeye with 10.5 million pink run size	16,800	1.07%	20,200	1.29%
(4) p50 forecast for both species with early pink migration timing	16,500	1.05%	19,200	1.23%
(5) p50 forecast for both species with sockeye non-retention	0	0.00%	4,800	0.31%
(6) p50 forecast for both species with higher northern diversion	4,200	0.27%	4,800	0.31%

Initially the base case scenario (median forecast for sockeye and pink salmon) indicated a total sockeye morality of 10,800 (9,500 catch + 1,300 fishing induced mortality, Table 1), but Canada considered this impact too high (i.e., not small but acceptable) and were also concerned about the use of gillnet gear during pink-directed fisheries openings. Under the non-retention scenario, the total FIMS would be 4,800. Canada indicated that the sockeye mortality associated with the non-retention scenario would be a good starting point to be considered small but acceptable. The U.S agreed to adjust its fishing plan to reduce the number of sockeye retained in Treaty Tribal fisheries. This resulted a new base case scenario with total sockeye mortality of 6,300 consisting of 5,300 catch and 1,000 FIM. The incidental harvest associated with this U.S. fisheries proposal was 0.34%. Across the different management groups, it had been mainly Late-run sockeye, Summer-run sockeye, and to a lesser extent Early Summer-run sockeye that were expected to be impacted, with 0.77%, 0.33% and 0.05% incidental harvest rates, respectively.

Both countries accepted this scenario as the base case. Canada clarified that these numbers were not targets but anticipated sockeye impacts. Both Parties agreed in the principles and constraints for 2023 that: 1) how the sockeye bycatch harvest occurs will be determined based on in-season information, and 2) retention of sockeye at returns that are below levels which generate international TAC will be discussed in-season prior to approval.

2023 in-season U.S. fisheries decisions

This summary is intended to review the U.S. fisheries proposed at the Fraser River Panel (FRP) meetings on August 18 and August 25 and their consequences. However, these two meetings should not be viewed in isolation as it would result in important context being omitted. Therefore, the following section will also review the proposed U.S. fisheries of August 22, as well as U.S. fisheries proposals after August 25 (Table A2).

Table A2: Overview of U.S. fisheries proposed at different Fraser River Panel (FRP) meetings in-season. U.S. fisheries proposals that were not approved by Canada are highlighted in blue, with the remainder being approved. For each fishery, the fishing gear (GN = drift gillnet, Net = drift gillnet and purse seine, PS = purse seine, and RN = reef net), dates, fishing times are noted, and if sockeye retention was permitted. Note that on August 22, the first U.S. fisheries proposal was not approved by Canada, but the second, amended proposal was.

Proposed U.S. fisheries	Gear	Dates	Times	Sockeye retention
18 Aug FRP meeting				
Treaty Tribal Fisheries				
Areas 4B, 5, 6C	GN	19-22 Aug	12 pm to 12 pm	Yes
Areas 6, 7 and 7A	Net	20 Aug	5 am to 9 pm	Yes
22 Aug FRP meeting – first proposal				
Treaty Tribal Fisheries				
Areas 4B, 5, 6C	GN	22-25 Aug	12 pm to 12 pm	Yes
Areas 6, 7, 7A	Net	23 Aug	5 am to 9 pm	Yes
All Citizen Fisheries				
Areas 7, 7A	PS	24 Aug	5 am to 9 pm	No
Areas 7, 7A	GN	24 Aug	8 am to 11:59 pm	No
Areas 7	RN	23, 24, 25 Aug	5 am to 9 pm daily	No
22 Aug FRP meeting – amended proposal				
Treaty Tribal Fisheries				
Areas 4B, 5, 6C	GN	22-25 Aug	12 pm to 12 pm	No
Areas 6, 7, 7A	Net	23, 25 Aug	5 am to 9 pm daily	No
All Citizen Fisheries				
Areas 7, 7A	PS	24, 25 Aug	5 am to 9 pm daily	No
Areas 7, 7A	GN	24, 25 Aug	8 am to 11:59 pm daily	No
Areas 7	RN	23, 24, 25 Aug	5 am to 9 pm daily	No
25 Aug FRP meeting				
Treaty Tribal Fisheries				
Areas 4B, 5, 6C	DN	25-30 Aug	12 pm to 12 pm	No
Areas 6, 7, 7A	Net	26-30 Aug	5 am to 9 am	No
All Citizen Fisheries				
Areas 7, 7A	PS	26, 27, 28, 29 Aug	5 am to 9 pm daily	No
Areas 7, 7A	GN	26, 27, 28, 29 Aug	8 am to 11:59 pm daily	No
Areas 7	RN	26, 27, 28, 29 Aug	5 am to 9 pm daily	No
29 Aug, 1, 5, 8 Sept FRP meetings				
Treaty Tribal Fisheries				
Areas 4B, 5, 6C	GN	30 Aug - 9 Sept	12 pm to 11:59 pm	No
Areas 6, 7, 7A	Net	30 Aug - 13 Sept	9 am to 11:59 pm	No
All Citizen Fisheries				
Areas 7, 7A	PS	30 Aug, …, 8 Sept	5 or 5:30 am to 9 pm daily	No
Areas 7, 7A	GN	30 Aug, …, 8 Sept	8 am to 9 or 11:59 pm daily	No
Areas 7	RN	30 Aug, …, 8 Sept	5 or 5:30 am to 9 pm daily	No

August 18 Fraser River Panel meeting

In 2023, the U.S.A. proposed its first fisheries at the meeting on August 18. At this meeting, PSC staff recommended an increase in the run size for Early Summer run sockeye to 310,000 while the pre-season forecast was 186,000. The forecast for Early Stuart had previously already been updated from 23,000 to 41,000. Despite the substantial increase in run size, both stocks remained managed under a LAER, as both were experiencing bigger migration challenges than expected pre-season due to high water temperatures in combination with record low discharge. For both stocks, the anticipated mortality due to en-route losses was expected to be higher than the total allowable mortality of 50%. At the August 18 meeting, PSC staff also recommended a reduced run size for Summer run sockeye of 800,000. This was the first in-season run size update for this management group for which 1,167,000 sockeye had been forecasted. While Canada raised concerns about potential en-route losses for this group, an in-season review by the Technical Committee of an additional retrospective analysis for years with migration conditions similar to 2023, as well as a comparison of past years with similarly high temperatures indicated that pre-season adopted Management Adjustment (MA) remained appropriate given the in-season environmental conditions. On August 18, it had still been too early to produce an in-season run size estimate for Late-run sockeye. Projections based on test fishery information however indicated that this management group was tracking above the expected pre-season forecast of 188,000. Also, all sockeye management groups appeared to be earlier timed than expected pre-season: Early Stuart 5 days earlier, Early Summer run 13 days earlier and Summer run 4 days earlier.

On August 18, pink salmon test fishing catches in both Johnstone Strait as well as Juan de Fuca Strait had been exceptionally high thus far, especially given pre-season expectations. In Juan de Fuca Strait, catches were dominated by Fraser River pink salmon compared to Canada South Coast and Washington stocks. At the Panel meeting on August 15, the Panel had increased the pink salmon run size from the pre-season forecast of 6.1 million to 8.6 million with a timing of August 18. At the August 18 meeting, PSC staff recommended an increase of the pink salmon run size to 17 million with an associated timing of August 13. While the run size of 17 million implied a higher productivity than in recent years it was not unprecedented. The timing was the earliest on record but was in line with the trend in recent years towards earlier pink salmon timing and increasing overlap with sockeye timing (the timing of Summer run sockeye was also estimated to be August 13). The adopted pink salmon run size increased the available international TAC to 11 million of which 25.7% was allocated to the U.S.A.

Following the adoption of the run size estimates, the U.S.A. proposed a pink-directed Treaty Tribal fishery in Areas 4B, 5, and 6C, and a Treaty Tribal fishery in Areas 6,7 and 7A with retention of sockeye. To reduce fishing effort and thereby increase the incidental harvest of sockeye, the U.S.A. restricted the fisheries to daylight (16 hours) and prohibited the commercial sale of sockeye in the pink-directed fishery, thereby removing any commercial fishing incentive. Given the lack of information on the extent the prohibition of commercial sockeye sale and the restriction to daylight fishing would have on the fishing effort, PSC staff used pre-season numbers on fishing effort which could be considered maximum estimates. The U.S. indicated that the modelled effort was likely high given the daylight hours of the proposed fishery but did not want to underestimate gillnet effort. The catch evaluation by PSC staff of these fisheries indicated there was enough U.S. pink salmon TAC for these fisheries to be prosecuted. Assuming pre-season fishing efforts, PSC staff also predicted 5,833 sockeye would be caught incidentally in this fishery, resulting in an incidental harvest rate of 0.44% (Table A3), which exceeded the incidental harvest rate of 0.34% of the base case fisheries planning scenario. Compared to pre-season expectation, the incidental harvest rate for Summer run sockeye was larger than predicted pre-season while the incidental harvest rates for Early Summer and Late run sockeye were smaller (Table A3).

Table A3: Overview of incidental catch, incidental harvest rates and total mortality rates of sockeye fisheries management groups in pink-directed U.S. fisheries proposed pre-season, as well as in-season on August 18, 22 and 25 and reported post-season. Pre-season estimates are predictions, while post-season estimates are reported estimates. In-season estimates are a mixture of in-season reports plus in-season predictions based on the proposed fisheries. Estimates associated with U.S. fisheries proposals that were not approved by Canada are highlighted in blue. Early Stuart has been excluded given the lack of predicted or observed catches.

	E.Summer	Summer	Lates	Total
Pre-season planned U.S. fisheries: based case scenario				
Total incidental catch	98	3,798	1,450	5,345
Total incidental harvest rate (excl. FIMs)	0.05%	0.33%	0.77%	0.34%
Total incidental mortality rate (incl. FIMs)	0.06%	0.39%	0.92%	0.41%
Aug 18 in-season U.S. fishery				
Predicted incidental catch	119	4,387	1,327	5,833
Incidental harvest rate (excl. FIMs)	0.04%	0.55%	0.71%	0.44%
Total incidental mortality rate (incl. FIMs)	0.04%	0.55%	0.71%	0.44%
Aug 22 in-season U.S. fishery – first proposal				
Observed + predicted incidental catch	111	2,444	1,357	3,912
Incidental harvest rate (excl. FIMs)	0.03%	0.26%	0.48%	0.24%
Total incidental mortality rate (incl. FIMs)	0.03%	0.26%	0.48%	0.24%
Aug 22 in-season U.S. fisheries – amended proposal				
Observed incidental catch	103	1,993	1,170	3,266
Incidental harvest rate (excl. FIMs)	0.03%	0.21%	0.42%	0.20%
Total incidental mortality rate (incl. FIMs)	0.03%	0.26%	0.49%	0.24%
Aug 25 in-season U.S. fisheries				
Observed incidental catch	57	2,302	1,325	3,684
Incidental harvest rate (excl. FIMs)	0.02%	0.24%	0.47%	0.23%
Total incidental mortality rate (incl. FIMs)	0.02%	0.31%	0.57%	0.28%
Post-season fisheries catch report				
Observed incidental catch	28	1,157	1,184	2,370
Total incidental harvest rate (excl. FIMs)	0.01%	0.12%	0.33%	0.14%
Total incidental mortality rate (incl. FIMs)	0.01%	0.16%	0.48%	0.19%

Canada strongly opposed the U.S. fisheries proposal (Table A4) citing conservation concerns for Early Summer run, Summer run and Late run, given that all sockeye management groups were in a LAER. In particular, Canada raised concerns about the retention of sockeye, the amount of sockeye expected to be harvested by the proposed U.S. fisheries, the gear used in the fishery and the fact that the proposed fishing area would include the Apex, which is the most northwest section of the U.S. Panel Area waters. Canada did not provide information on what they would consider small but acceptable sockeye impacts. The U.S.A. decided to move forward with their fishery plans, given that it considered Canada's request to modify its proposal domestic fisheries management decisions outside the purview of Chapter 4. As the U.S. opposed Canada's objections, the U.S.A. provided a letter of rationale to the Panel preceding the start of their fishery on August 19, as per Chapter 4, paragraph 13diii. On August 18, prior to the opening of this U.S. pink-directed fishery, catches to date totaled about 16,000 sockeye with about 11,000 caught by the test fisheries and 5,000 caught by Canada, predominantly consisting of unauthorized directed retention or unauthorized bycatch retention in fisheries directed at other species. In addition, close to 2,800 Fraser

River pink salmon had been caught primarily by the test fishery as well as Canadian fisheries directed at other pink salmon stocks.

Table A4: Summary of the U.S. rationale for the U.S. fisheries proposed on August 18, 2023 and the Canadian concerns communicated in-season and post-season.

U.S. rationale for August 18 fisheries proposal	Canadian concerns with the August 18 proposal
• The U.S. proposal included a limited Treaty Indian fishery. • U.S. Tribes have cultural beliefs enshrined in their respective laws and fishing regulation that require their fishers to retain all catch, including by-catch to prevent wastage. • The prohibition of the commercial sale of sockeye and the shortening (16h daylight) of the fishery were expected to remove the commercial incentive to target sockeye and reduce fishing effort. • The modelled fishing effort by PSC staff was likely high given the daylight hours of the proposed fishery but the U.S.A. did not want to underestimate gillnet effort. • PSC staff predicted the proposed U.S. fisheries would result in an overall exploitation rate (ER) of 0.44% for sockeye (0.04% ER for Early Summer, 0.55% ER for Summer and 0.71% ER for Late run sockeye). • The U.S.A. viewed this as a small but acceptable amount of incidental harvest of sockeye in a pink-directed fishery projected to harvest 289,000 pink salmon. • The proposed U.S. fishery would bring the total ER to date, including test fishing and unsanctioned catch, to 1.74%, which is below the 10% LAER. • Delay of the fishery would prevent the U.S.A. to access the pink salmon TAC given the significantly earlier run timing observed. • Canada refused to indicate the amount they consider as small but acceptable, indicating it depends on the context. • Canada requested the release of all incidentally caught sockeye, modification of the fishing gear used and a reduced fishing area. • The U.S.A. views Canada's requests domestic fisheries management decisions, including intertribal allocation concerns. • The U.S.A. views Canada's requests outside the purview of Chapter 4 and beyond the language regarding small but acceptable incidental harvest.	In-season concerns • Canada requested the U.S.A. to consider options to reduce the impacts of the U.S. fisheries on sockeye salmon through: o reduced sockeye retention, o closure of the Apex, and o using gillnet gear with a mesh size smaller than five inches to target pink salmon rather than sockeye. • Canada indicated that they would consider a limited purse seine fishery proposal with sockeye non-retention acceptable. Post-season concerns • Canada indicates that the U.S. fisheries proposal appears inconsistent with prioritizing escapement above international allocation, above domestic objectives. • Canada's view of small but acceptable is that no fisheries in Panel waters should retain sockeye when no TAC is available. • When fisheries have been designed, to the extent practical, to avoid incidental mortality, some sockeye mortality may occur. • Choices of fishing area, gear and retention that prioritize accessing pink salmon TAC rather than meeting escapement targets for sockeye salmon incur unnecessary sockeye mortality. • In Canada's view, sufficient efforts were not made, to the extent practicable, to minimize impacts on sockeye salmon in pink salmon fisheries. • As a result, the amount of incidental sockeye salmon harvest is not acceptable to Canada.

August 22 Fraser River Panel meeting

At the next Fraser River Panel meeting on August 22, PSC staff recommended an increase in run size for Early Summer run, Summer run and Late run. The recommended run sizes for Early Summer run (335,000) and Late run (280,000) were substantially larger than their pre-season forecast (186,000 and 188,000 respectively). Only for Summer run did the in-season adopted run size (950,000) remain below the pre-season forecast of 1,166,000. Despite the substantial increase in run size, all sockeye management groups remained managed under a LAER. The estimated timing of the Late run group (August 17) was later than assumed pre-season (August 24) and confirmed the overall earlier timing across sockeye management groups. For Late run, it was also estimated that approximately 54,000 sockeye were delaying their

upstream migration into the Fraser River. No changes were made to the in-season estimate of pink salmon run size or timing.

Catches to date totaled about 22,000 sockeye with about 13,000 caught by the test fisheries and 5,000 caught by Canada, predominantly consisting of unauthorized directed retention or unauthorized bycatch retention in fisheries directed at other species. The U.S.A. reported a Treaty Tribal catch of 3,266 sockeye salmon. This was less than the 5,833 sockeye predicted, mainly due to lower fishing effort than was assumed to generate the predictions. In addition, close to 48,000 Fraser River pink salmon had been caught primarily by the U.S. Treaty Tribal fishery.

Following the adoption of the run size estimates, the U.S. proposed a pink-directed Treaty Tribal fishery in Areas 4B, 5, and 6C, and a Treaty Tribal fishery in Areas 6,7 and 7A with retention of sockeye, as well as All Citizen fisheries in Area 7 and 7A with release of sockeye (Table A2). The fisheries openings in Areas 6, 7 and 7A had been reduced to one day and restricted to daylight (16 hours) to limit fishing effort. In addition, no commercial sale of sockeye was allowed and there would be no tender boats, thereby limiting the capacity to fish. The catch evaluation by PSC staff of these fisheries indicated there was enough U.S. pink salmon TAC for these fisheries to be prosecuted. PSC staff predicted an additional sockeye catch for the proposed Treaty Tribal fisheries of 646 sockeye. Added to the 3,266 sockeye caught and reported by the Treaty Tribal fishery on August 20, the resulting incidental harvest rate for sockeye totalled 0.24%, which was lower than the in incidental harvest rate of 0.34% of the base case fisheries planning scenario (Table A3). Canada indicated that the concerns raised at August 18 meeting remained the same: the use of gear intended for catching sockeye and not pink salmon, fishing in the Apex where sockeye could be more vulnerable and the retention of sockeye in Treaty Tribal fisheries.

Taking into account Canada's feedback, the U.S.A. amended their fisheries proposal by requiring the release of sockeye in all Treaty Tribal fisheries and by extending the Treaty Tribal fisheries in Areas 6,7, 7A, and the All Citizen fisheries in Area 7, 7A to two days instead of one. This reduced the incidental harvest rate of sockeye salmon from 0.24% to 0.20%. No adjustments to the fishing area or the gear used were made. Canada acknowledged the U.S. effort to reduce sockeye mortalities and approved the fishery proposals.

August 25 Fraser River Panel meeting

At the August 25 Panel meeting, it was reported that sockeye catch in marine test fisheries continued to decline with the majority being caught in Area 12, indicating a shift in migration through Johnstone Strait rather than Juan de Fuca Strait. Approximately 72,000 Late run sockeye were estimated to be delaying their entry into the Fraser River. Pink salmon test fishing catches had reportedly increased in Juan de Fuca Strait, as had the proportion of Fraser pinks. Pink salmon catch in the Fraser River had substantially increased and a total of 533,000 had been observed migrating past Mission. There were no updates made to the sockeye or pink salmon run size. Sockeye catches to date totalled 24,000 with close to 15,000 caught by test fisheries, more than 5,000 reported by Canada in terms of unauthorized catch. The U.S.A. reported a catch of 3,684 sockeye of which 360 had been retained without authorisation.

The U.S. proposed a pink-directed Treaty Tribal fishery in Areas 4B, 5, and 6C, and a Treaty Tribal fishery in Areas 6,7 and 7A, as well as All Citizen fisheries in Area 7 and 7A, both with release of sockeye (Table A2). The catch evaluation by PSC staff of these fisheries indicated there was enough U.S. pink salmon TAC for these fisheries to be prosecuted. Given that these fisheries assumed no sockeye retention, the total incidental harvest rate remained at 0.23% given the current reported catch of 3,684 sockeye (Table A3).

The U.S.A. noted that there had been more limited participation than expected in U.S. fisheries due to the decrease in market prices, and for the proposed fisheries, the U.S.A. expected lower or equivalent fishing effort. In addition, sockeye interceptions thus far had been low and continued to decrease. PSC staff predicted there was enough U.S. pink salmon TAC for these fisheries to be prosecuted. Given that all proposed U.S. fisheries assumed non-retention, there were no additional incidental sockeye harvest rates, but adjustments to the reported catches resulted in an updated incidental harvest rate of 0.23%.

Despite the proposed non-retention of sockeye, Canada opposed the U.S. fishery proposal (Table A5). In particular Canada was concerned with the impact of fisheries in the Apex on Late run sockeye, while the U.S.A. could harvest its pink salmon TAC in U.S fishing areas instead. Canada was concerned about the successful return of Late Shuswap fish given the impact of wildfires near the spawning areas. The U.S.A. indicated that the Apex has provided sockeye fishing opportunities in years of high diversion, but given the current limited fishing effort, the impact of restricting fishing access to the Apex would have a limited impact on sockeye mortalities. PSC staff could not provide a clear indication if sockeye encounter rates would be higher in the Apex compared to other U.S. fishing areas.

Table A5: Summary of the U.S. rationale for the U.S. fisheries proposed on August 25, 2023 and the Canadian concerns communicated in-season and post-season.

U.S. rationale for August 25 fisheries proposal	Canadian concerns with the August 25 proposal
• PSC staff predicted the proposed U.S. fisheries would result in a fishing induced sockeye mortality rate of 0.06% (0.00% for Early Summer, 0.06% for Summer and 0.10% for Late run sockeye). • The proposed U.S. fishery would bring the exploitation rate to date, including fishery-induced mortality and including test fishing and unsanctioned catch, to 1.68%, which is below the 10% LAER. • The U.S.A. viewed this as a small but acceptable amount of incidental mortality of sockeye in a pink-directed fishery projected to harvest 1,223,000 pink salmon. • A similar U.S. fisheries proposal had been agreed to by Canada on August 22. • The likely U.S. fishing effort in all areas is likely to be lower than modelled given 8 Tribal and 4 All Citizen purse seines participated in the August 23-24 U.S. fishery opening, and no gillnets. • Canada's insistence of closing the Apex to protect Late run sockeye is not supported by the very small number of sockeye expected to be impacted by the U.S. fisheries and the fact that all sockeye encountered would be released.	In-season concerns • Canada noted concerns about the impact of the proposed fisheries on Late run sockeye caught in the Apex. • Canada was concerned about the successful return of Late Shuswap given the impact of wildfires near the spawning areas. • Canada requested the U.S. to shorten the proposed U.S. fisheries by two days to assess the sockeye catches in the Apex and evaluate if there was any value in closing the Apex Post-season concerns • Canada indicates that the U.S. fisheries proposal appears inconsistent with prioritizing escapement above international allocation, above domestic objectives. • When fisheries have been designed, to the extent practical, to avoid incidental mortality, some sockeye mortality may occur. • Choices of fishing area, gear and retention that prioritize accessing pink salmon TAC rather than meeting escapement targets for sockeye salmon incur unnecessary sockeye mortality. • In Canada's view, sufficient efforts were not made, to the extent practicable, to minimize impacts on sockeye salmon in pink salmon fisheries. • As a result, the amount of incidental sockeye salmon harvest is not acceptable to Canada.

Canada requested modifications to the U.S. fisheries proposal: provided the length of the fisheries opening was shortened until Sunday August 27, Canada would be willing to adopt the U.S. proposal. At that time, sockeye catches and associated release mortality would be evaluated to determine if there was value in closing the Apex. This would also require a Panel meeting on the following Monday, one day earlier than normal. The U.S.A. proposed to shorten the proposed fishery by one day, not two. This was rejected by

Canada. The U.S.A. felt this would diminish the effectiveness of the pink-directed fishery and went back to the original fishery proposal, which Canada did not approve.

August 29 to September 8 Fraser River Panel meetings

During the next 4 Fraser River Panel meetings (August 29, September 1, 5 and 8) the U.S.A. continued to propose pink-directed Treaty Tribal and All Citizen fisheries without sockeye retention. Canada remained concerned about the impact of these fisheries on Late-run sockeye, in particular when fishing in the Apex, but approved them.

Appendix 2: Rationale letter in support of U.S. fisheries as adopted on August 18, 2023

August 19, 2023

Mr. John Field
Executive Secretary, Pacific Salmon Commission

Subject: Rationale letter, pursuant to Chapter 4, Section 13(d) iii of the 2019 Pacific Salmon Treaty, in support U.S. National Section Fraser Panel fisheries, as adopted on August 18, 2023

Chapter four of the January 2019 Pacific Salmon Treaty between the United States and Canada defines the management of fisheries directed at Fraser River sockeye and pink salmon, through the Fraser River Panel ("Panel"). Within Chapter four, paragraph 13 outlines the process that the Panel will use to manage the Panel fisheries in season. Within paragraph 13, subsections (a), (b), (c) and (d) outline the process by which the Fraser Panel can approve a fishery regulation, proposed by one National Section of the Panel, within their domestic Panel waters, when the other National Section of the Panel does not support the Party's proposed fishery. Chapter four, paragraph 13, subsection (a) states that:

> *"…PSC staff shall provide the Fraser River Panel with recommendations for in-season run size and other factors relevant to sound fisheries management decisions. Based on information such as, but not limited to, in-season estimates of run timing and diversion rate, the PSC staff shall make recommendations to the Fraser Panel regarding in-season decision making".*

Subsection (b) states that:

> *"PSC staff shall provide the Fraser River Panel with projected harvestable surpluses and status of harvest from fisheries under Panel management…"*

Subsection (c) states that:

> *"…Acceptance of the PSC staff recommendation requires approval of at least one of the National Sections".*

And, subsection (d) states that:

> *" …respective National Sections of the Panel will develop proposed regulations for their domestic Panel Area fisheries consistent with recommendations and projections provided by the PSC staff as described in 13(a) and 13(b)"….and,*
>
> *"PSC staff shall assess and provide advice as to whether proposed fishery regulations for Panel Area fisheries are consistent with recommendations and projections described in 13(a) and 13(b) and Panel objectives."*

Additionally, subsection (d) states that:

> *"Subsequently, after full discussion of a Panel Area fishery proposal, the following may occur: (i) the Panel may adopt the proposal based on bilateral agreement or; (ii) the proposing National Section may modify and re-submit its proposal in response to advice from staff and/or concern(s) raised by the other National Sections; or (iii) while acknowledging objection(s) of the other National Sections, the Panel shall approve the fishery proposal". And,*
>
> *"In the event that the Panel approves a fishery under the provisions of the later circumstance (13(d)(iii)), prior to commencement of the proposed fishery, the proposing National section must provide a written rationale for the fishery as submitted".*

This letter is meant to fulfill the written rational requirement of Chapter 4, paragraph 13, section (d)(iii).

The Fraser River Panel met at 1:00pm on August 18, 2023, for an in-season Panel meeting. At this meeting the PSC staff went over the latest "distribution" document of updated Fraser River sockeye and pink salmon run assessment. After reviewing the available information, the PSC staff recommended the following updates to the Panel:

> Early Summer management group: An increase in run size to 310,000 and an Area 20 run timing of July 24.
>
> Summer management group: A decrease in run size to 800,000 and an Area 20 run timing of August 13.
>
> Pink salmon: Increase in the run size to 17,000,000 and an Area 20 timing of August 13.

The PSC staff presented tables of predicted catches and mortalities, of pink and sockeye salmon, in pink-directed fisheries in the U.S. Panel Area waters, as requested by the Panel in a prior meeting.

The U.S. National Section of the Panel met in a caucus to deliberate the recommended run-size updates, the implications for total allowable catch (TAC) of Fraser pink salmon, the potential incidental harvest of Fraser sockeye, and to craft a potential fishery proposal. The U.S. National Section developed and proposed the following fisheries to the full Panel:

> **TREATY TRIBAL FISHERY:**
>
> Areas 4B, 5, and 6C: Open for drift gillnet fishing from 12 p.m. (noon), Saturday, August 19, 2023, through 12 p.m. (noon), Tuesday, August 22, 2023.
>
> Areas 6, 7, and 7A: Open for net fishing from 5 a.m. through 9 p.m., Sunday, August 20, 2023.

Both National Sections agreed to adopt the PSC staff recommendations for updates to the sockeye and pink salmon run sizes and timing. However, the Canadian section did not support the U.S. fisheries, as proposed.

Both parties have expressed their concern for the Fraser River sockeye and the need for conservation. The sockeye run has been carefully monitored and management adjustments are in place to account for in-river losses from the environmental conditions. The Canadian National Section stated their concerns with the U.S. fishery directed at pink salmon including the amount of sockeye that would be incidentally harvested, the types of gear that would be used in the fishery, and the area in which the fisheries would occur. Canada suggested that the U.S. tribes release all sockeye, use a different mesh size for the gillnets, use only purse seine gear, and/or close areas of the fishery, including the Apex.

Chapter 4, paragraph 3, subsection (g) states that:

> "*To the extent practicable, the Panel shall develop and implement a fishing plan that provides the U.S. fishery with the opportunity to harvest its 25.7 percent share of the Fraser River pink salmon TAC".*
>
> and that;
>
> *"It is understood that the overlapping of sockeye and pink salmon migrations may result in a small but acceptable rate of incidental harvest on one or more overlapping sockeye management groups that have little or no TAC as defined in this Chapter".*

The U.S. National Section of the Panel section has requested from the Canadian section the amount of incidental sockeye catch would be considered small and acceptable to them. The Canadian National Section has refused to indicate the amount that they would consider as small and acceptable indicating that it depends on the context and adding that they would like the U.S. to release all incidentally caught sockeye, modify the fishing gears used, and reduce the fishing area. The U.S. views these requests as being domestic fishery management decisions, including intertribal allocation concerns, and outside the purview of Chapter 4 and well beyond the language regarding small but acceptable incidental harvest. Furthermore, the U.S. Section of the Panel has clearly articulated that many of the U.S. tribal fisheries operating in Panel-controlled waters primarily or exclusively use gillnet gear. The U.S. tribes also have cultural beliefs, enshrined in their respective laws and fishing regulations that require their fishers to retain all catch, including bycatch, for sampling purposes and to prevent wastage.

As shown in Table 1, the estimated pink salmon TAC available to the U.S. fisheries totaled 2,820,510, based on the 17,000,000-run size adopted by the Panel at this meeting (August 18, 2023). The proposed U.S. fisheries would access only a small portion of this available pink salmon TAC, through implementing a limited Treaty Indian fishery. The proposal included a very small effort (up to 3 boats) drift gillnet fishery in the Strait of Juan de Fuca (Areas 4b, 5, and 6c) as well as a shortened (16hr), daylight fishery (5:00 a.m. to 9:00 p.m.), for purse seine and drift gillnet in the San Juan Island area (Areas 6, 7, and 7A). It was presented that the

modelled drift gillnet effort in Area 6, 7, and 7A was likely estimated high, given the daylight hours of the proposed fishery, but the U.S. stated that they did not want to potentially underestimate the predicted gillnet effort. Additionally, the U.S. agreed to prohibit the commercial sale of sockeye in the pink-directed fisheries in order to remove any commercial incentive for targeting sockeye.

The U.S. indicated that if the fisheries were delayed that it would reduce the ability of the U.S. to attain the available U.S. pink salmon TAC, given the significantly early run timing observed thus far in season. The PSC evaluated the U.S. fishery proposals and determined that the catch would not exceed the available U.S. portion of the pink TAC, based on the current adopted run size, and provided an assessment of the associated estimated sockeye mortality (Table 1). The proposed fisheries were projected to result in an overall exploitation rate of 0.44% for sockeye (0.04% ER for Early Summer, 0.55% ER for Summer, and 0.71% ER for Late Run sockeye). The U.S. Section views this as a small and acceptable amount of sockeye mortality in a pink-directed fishery projected to harvest 289,000 Pink salmon.

The PSC staff estimated that the proposed U.S. fisheries would result in the following level of catches based on current in-season projections of pink and sockeye salmon in the U.S. Panel waters:

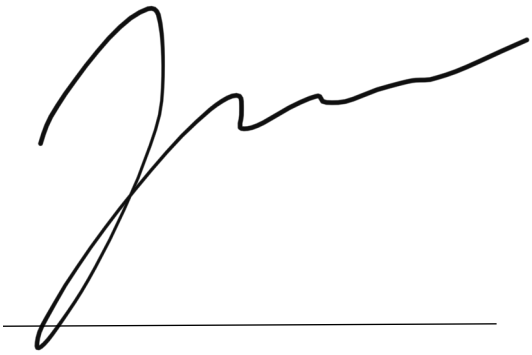
Table 1.

	Pink	Sockeye			
		Early Summer	Summer	Late	**Total Sockeye**
Treaty Tribal Fishery	In-season Catch Projections				
4B, 5, 6C	393	4	230	74	**309**
6, 7, 7A	288,719	115	4,156	1,253	**5524**
Total	**289,111**	119	4,386	1,327	**5,833**
U.S. TAC	2,820,510	0	0	0	**0**
Remaining U.S. TAC	2,531,399	-119	-4,386	-1,327	**-5,833**
LAER	-	10%	10%	10%	**-**
Proposed Fishery estimated ER	-	0.04%	0.55%	0.71%	**0.44%**
Total ER (including proposed fisheries)	-	1.44%	2.75%	1.41%	**1.74%**

At the current adopted run sizes of Fraser sockeye salmon, all management groups are being managed under a 10% low abundance exploitation rate (LAER) limit and there is no available TAC for international sharing, as shown in Table 1. The proposed U.S. fisheries would incidentally harvest an estimated 5,833 Fraser River sockeye and would result in an only a minor increase in the overall and management group-specific exploitation rates (Table 1).

The U.S. believes that the level of incidental harvest of Fraser River sockeye salmon and particularly the summer management group represents, reasonably, a small but acceptable impact

in pursuit of harvesting a portion of the available U.S. TAC on Fraser River pink salmon.



Jason Gobin, Tulalip Tribe

Fraser Panel Vice-Chair

Appendix 3: Rationale letter in support of U.S. fisheries as adopted on August 25, 2023

August 25, 2023

Mr. John Field
Executive Secretary, Pacific Salmon Commission

Subject: Rationale letter, pursuant to Chapter 4, Section 13(d) iii of the 2019 Pacific Salmon Treaty, in support U.S. National Section Fraser Panel fisheries, as adopted on August 25, 2023

Chapter four of the January 2019 Pacific Salmon Treaty between the United States and Canada defines the management of fisheries directed at Fraser River sockeye and pink salmon, through the Fraser River Panel ("Panel"). Within Chapter four, paragraph 13 outlines the process that the Panel will use to manage the Panel fisheries in season. Within paragraph 13, subsections (a), (b), (c) and (d) outline the process by which the Fraser Panel can approve a fishery regulation, proposed by one National Section of the Panel, within their domestic Panel waters, when the other National Section of the Panel does not support the Party's proposed fishery. Chapter four, paragraph 13, subsection (a) states that:

> *"…PSC staff shall provide the Fraser River Panel with recommendations for in-season run size and other factors relevant to sound fisheries management decisions. Based on information such as, but not limited to, in-season estimates of run timing and diversion rate, the PSC staff shall make recommendations to the Fraser Panel regarding in-season decision making".*

Subsection (b) states that:

> *"PSC staff shall provide the Fraser River Panel with projected harvestable surpluses and status of harvest from fisheries under Panel management…"*

Subsection (c) states that:

> *"…Acceptance of the PSC staff recommendation requires approval of at least one of the National Sections".*

And, subsection (d) states that:

> *" …respective National Sections of the Panel will develop proposed regulations for their domestic Panel Area fisheries consistent with recommendations and projections provided by the PSC staff as described in 13(a) and 13(b)"….and,*
>
> *"PSC staff shall assess and provide advice as to whether proposed fishery regulations for Panel Area fisheries are consistent with recommendations and projections described in 13(a) and 13(b) and Panel objectives."*

Additionally, subsection (d) states that:

> *"Subsequently, after full discussion of a Panel Area fishery proposal, the following may occur: (i) the Panel may adopt the proposal based on bilateral agreement or; (ii) the proposing National Section may modify and re-submit its proposal in response to advice from staff and/or concern(s) raised by the other National Sections; or (iii) while acknowledging objection(s) of the other National Sections, the Panel shall approve the fishery proposal". And,*
>
> *"In the event that the Panel approves a fishery under the provisions of the later circumstance (13(d)(iii)), prior to commencement of the proposed fishery, the proposing National section must provide a written rationale for the fishery as submitted".*

This letter is meant to fulfill the written rational requirement of Chapter 4, paragraph 13, section (d)(iii).

The Fraser River Panel met at 11:00am on August 25, 2023, for an in-season Panel meeting. At this meeting the PSC staff went over the latest "distribution" document of updated Fraser River sockeye and pink salmon run assessment. After reviewing the available information, including the catch from the prior U.S. fishery opening (August 22-25), the PSC staff had no, new recommendations for sockeye or pink salmon run sizes or timing. All sockeye management units are still being managed under a low abundance exploitation rate (LAER) limit of 10% and the Fraser pink salmon are estimated at a 17M run size. It should be noted that the prior U.S. Panel fisheries were agreed-to by the Canadian National Section at the August 22 Panel meeting.

U.S. Section of the Panel, on many occasions, has clearly articulated that the U.S. tribes have cultural and religious beliefs, enshrined in their respective laws and fishing regulations, that require their fishers to retain all catch, including bycatch, for sampling purposes and to prevent wastage. Even so, the U.S. Panel Section agreed to implement non-retention of sockeye salmon in all fisheries proposed and agreed to at the August 22 Panel meeting.

The PSC staff presented tables of predicted catches and mortalities, of pink and sockeye salmon, in pink-directed fisheries in the U.S. Panel Area waters, as requested by the Panel in a prior meeting.

Based on the available amount of remaining pink salmon TAC and the continued low level of sockeye encounters and resulting fishing-induced mortalities (FIMs) the U.S. National Section of the Panel proposed the following fisheries to the full Panel:

TREATY TRIBAL FISHERY:

Areas 4B, 5, and 6C: Extend for drift gillnet fishing from 12 p.m. (noon), Friday, August 25, 2023 through 12 p.m. (noon), Wednesday, August 30, 2023. Sockeye must be released.

Areas 6, 7, and 7A: Open for net fishing 5 a.m., Saturday, August 26, 2023 through 9 a.m., Wednesday, August 30, 2023. Sockeye must be released.

ALL CITIZEN FISHERY:

Areas 7 and 7A: Open for purse seine fishing 5 a.m. through 9 p.m., Saturday, August 26, 2023; 5 a.m. through 9 p.m., Sunday, August 27, 2023; 5 a.m. through 9 p.m., Monday, August 28, 2023; and 5 a.m. through 9 p.m., Tuesday, August 29, 2023. Sockeye must be released.

Areas 7 and 7A: Open for drift gillnet fishing from 8 a.m. through 11:59 p.m., Saturday, August 26, 2023; 8 a.m. through 11:59 p.m., Sunday, August 27, 2023; 8 a.m. through 11:59 p.m., Monday, August 28, 2023; and 8 a.m. through 11:59 p.m., Tuesday, August 29, 2023. Sockeye must be released.

Area 7: Open for reef net fishing 5 a.m. through 9 p.m., Saturday, August 26, 2023; 5 a.m. through 9 p.m., Sunday, August 27, 2023; 5 a.m. through 9 p.m., Monday, August 28, 2023; and 5 a.m. through 9 p.m., Tuesday, August 29, 2023. Sockeye must be released.

The Canadian Panel expressed concern regarding fishing activities in the Apex area, particularly for impacts to the Late run sockeye management group. The Apex is a specific, triangle shaped area identified in the PST, Chapter 4, in the most northwest section of the U.S. Panel area waters. This subarea of U.S. Area 7A is used by the Panel to control potential impacts to Fraser fish that delay in the gulf area off of the mouth of the Fraser River. Historically, this has been used to reduce potential impacts to the Late run sockeye management group, particularly when that group has no international TAC available and while prosecuting U.S. fisheries with retention of sockeye salmon allowed – sockeye and pink-directed fisheries. The Canadian Panel Section did not express other concerns with the U.S. proposal.

The U.S. Panel Section went into a caucus to discuss potential modifications to the proposed fisheries considering the Canadian concerns. The U.S. Section discussed the implications to the fishery of not fishing in the Apex area, including reduced efficiency in catching pink salmon, the cost of running to other areas within Areas 7 and 7A, and the reduced effort expected, based on the prior openings. The U.S. Section discussed the potential for reduced hours of fishing operations – opening only during daylight hours (5:00am-9:00pm). We also discussed the idea of shortening the proposed opening by a day, in an attempt to reduce the fishing time and potential sockeye encounters. The U.S. Chair exchanged these ideas with the Canadian Chair, while both Sections were in caucus. These modifications to the proposal were rejected by the Canadian Section, with a counter-proposal to fish only two days and to potentially have a Panel meeting on the following Monday, one day earlier than normal.

Ultimately, the U.S. Section felt that the demands of the Canadian Panel Section would diminish the effectiveness of the pink-directed fishery – both in terms of efficiency at attaining pink TAC and in terms of stability of schedule for the fishers. The U.S. went back to the original fishery proposal (detailed above).

Chapter 4, paragraph 3, subsection (g) states that:

> "*To the extent practicable, the Panel shall develop and implement a fishing plan that provides the U.S. fishery with the opportunity to harvest its 25.7 percent share of the Fraser River pink salmon TAC".*
>
> and that;
>
> *"It is understood that the overlapping of sockeye and pink salmon migrations may result in a small but acceptable rate of incidental harvest on one or more overlapping sockeye management groups that have little or no TAC as defined in this Chapter".*

The U.S. National Section of the Panel section has requested from the Canadian section the amount of incidental sockeye catch would be considered small and acceptable to them. For the prior U.S. fishery opening, the Canadian National Section refused to indicate the amount that they would consider as small and acceptable. However, they did agree to U.S. fisheries that would release all incidentally caught sockeye (alive or dead), which the U.S. Section agreed to, with a great amount of difficulty in the tribal fisheries. The Canadian insistence on the U.S. closing the Apex, to protect the Late run sockeye group, is not supported by the very small number of sockeye, in total, forecast to be impacted by the U.S. fisheries (Table 1), and given that the fisheries are already releasing all sockeye encountered, would not be consistent with how the Apex closure has been implemented in the past, usually involving fishing that retains sockeye.

The U.S. Section of the Panel has received requests from the Canadian Panel Section to modify the fishing gears used in U.S. waters, to release all incidentally caught sockeye (which we've agreed to), and reduce the U.S. fishing area. The U.S. views these requests as being domestic fishery management decisions, including intertribal allocation concerns, and outside the purview of Chapter 4 and well beyond the language regarding small but acceptable incidental harvest.

As shown in Table 1, the estimated pink salmon TAC available to the U.S. fisheries totaled 2,725,010, based on the 17,000,000-run size adopted by the Panel at the August 18, 2023 Panel meeting. The proposed U.S. fisheries would access less than half of this available pink salmon TAC. The likely effort in all areas is expected to be lower than modeled, given the low prices for pink salmon, domestic Chinook salmon constraints, and the non-retention of sockeye, including for tribal ceremonial and subsistence use. In the U.S. openings on 8/23/2023 and 8/24/2023 there were eight tribal and four all-citizens purse seines respectively, and no gill nets.

The PSC evaluated the U.S. fishery proposals and determined that the catch would not exceed the available U.S. portion of the pink TAC, based on the current adopted run size, and provided an assessment of the associated estimated sockeye mortality (Table 1). The proposed fisheries were projected to result in an overall exploitation rate of 0.06% for sockeye (<0.00% ER for Early Summer, 0.06% ER for Summer, and 0.10% ER for Late Run sockeye). The U.S. Section views this as a small and acceptable amount of sockeye mortality in a pink-directed fishery projected to harvest 1,223,452 Pink salmon.

The PSC staff estimated that the proposed U.S. fisheries would result in the following level of catches based on current in-season projections of pink and sockeye salmon in the U.S. Panel waters:

Table 1.

	Pink	Sockeye			Total
		Early Summer	Summer	Late	
Total U.S. Fisheries	Catch Projection	In-season FIM Projections			
4B, 5, 6C	7,819	0	16	8	24
6, 7, 7A	1,215,633	4	590	267	861
Total	1,223,452	4	606	275	885
U.S. TAC Remaining	2,725,010	0	0	0	**0**
Difference with Fishery Projection	1,501,558				
LEAR	-	10%	10%	10%	-
Proposed Fishery ER	-	0.00%	0.06%	0.10%	**0.06%**
Total ER	-	1.88%	1.72%	1.37%	**1.68%**

At the current adopted run sizes of Fraser sockeye salmon, all management groups are being managed under a 10% low abundance exploitation rate (LAER) limit and there is no available TAC for international sharing, as shown in Table 1. The proposed U.S. fisheries would result in the incidental mortality (through catch and release) of an estimated 885 Fraser River sockeye and would result in an only a minor increase in the overall and management group-specific exploitation rates (Table 1).

The U.S. believes that the level of incidental harvest of all remaining Fraser River sockeye salmon management groups represents, reasonably, a small but acceptable impact in pursuit of harvesting a portion of the available U.S. TAC on Fraser River pink salmon.

Jason Gobin, Tulalip Tribe

Fraser Panel Vice-Chair

Appendix 4: Canadian response to August 18 and August 25, 2023 rationale letters

October 6, 2022

Mr. Jason Gobin
Vice-Chair, Fraser River Panel

Re: Response to August 18 and August 25, 2023 rationale letters, pursuant to Chapter 4, Section 13(d) iii of the 2019 Pacific Salmon Treaty

Dear Jason,

Thank you for your letters pursuant to Chapter 4, section 13(d)(iii) of the 2019 Pacific Salmon Treaty (PST). On August 18 and August 25 the Fraser River Panel acknowledged objections of the Canadian National Section and approved fisheries in United States (U.S.) Fraser Panel Area waters. The Canadian National Section objected to these fisheries as they appear to be inconsistent with our shared conservation objective.

The Canadian National Section continues to root its decisions within the prioritized objectives of the PST as described in Chapter 4, section 10:

> *The Parties agree that Panel management actions should meet the following objectives, listed in order of priority:*
> *(a) obtain spawning escapement goals by stock or stock grouping;*
> *(b) meet Treaty defined international allocation; and*
> *(c) achieve domestic objectives.*

The Canadian National Section's hope is that a clearer articulation of these objectives and an understanding about how to achieve these objectives can lead to consensus for future fishery decisions.

Interpretation of treaty language appears to be the primary point of misalignment. More specifically, a lack of agreement about "small but acceptable," and "to the extent practicable" (see Chapter 4, sections 3(e),(g)). As discussed in our pre-season meetings, both countries agree that the definition of "small but acceptable" depends on the context of a fishery proposal. It is the view of the Canadian National Section that stock or stock grouping abundance, relative to escapement goals, is the primary component in defining a small but acceptable level of mortality. The Canadian National Section also believes that "to the extent practicable" provides essential context to assess "small but acceptable."

Based on the current PST language, the Canadian National Section's view of "small but acceptable" is that no fisheries in Panel waters should be designed to retain Sockeye salmon when no total allowable catch (TAC) is available. Where fisheries have been designed, to the extent practicable, to avoid incidental mortality, it is understood that some Sockeye salmon mortality may occur. It is the view of the Canadian National Section that the U.S. National Section made fishery management choices about area, gear, and retention rules that prioritized

accessing Fraser Pink salmon TAC, rather than meeting escapement targets for Fraser Sockeye salmon, and incurred unnecessary Sockeye salmon mortalities.

Based on the August 18 and August 25 correspondence, I understand that the U.S. believes that the level of incidental harvest of Sockeye salmon was a small but acceptable impact in pursuit of harvesting a portion of the available U.S. Pink salmon TAC. I also understand that the U.S. views requests by the Canadian National Section to release all incidentally-caught Sockeye salmon, modify the fishing gears used, and reduce the fishing area as U.S. domestic fishery management decisions. While the U.S. considered fishing area and gear modifications at Canada's request, the U.S Nation Section felt such changes "would reduce the ability of the U.S. to attain the available U.S. pink salmon TAC" and "would diminish the effectiveness of the pink-directed fishery – both in terms of efficiency at attaining pink TAC and in terms of stability of schedule for the fishers."

It is the view of the Canadian National Section that sufficient efforts were not made, to the extent practicable, to minimize impacts on Sockeye salmon in Pink salmon fisheries. As a result, the amount of incidental Sockeye salmon harvest is not acceptable to Canada. The rationale outlined in the August 18 and August 25 letters implies that U.S. domestic objectives (i.e. fishery efficiency) were prioritized over spawning escapement goals. It is the Canadian National Section's view that escapement goals for co-migrating stocks must be better prioritized ahead of accessing TAC for other stocks.

Looking toward future fishing seasons, the Canadian National Section is reflecting on how we can collectively design and assess fishery proposals to achieve our priority conservation objective. The environmental and biological realities facing Fraser salmon will require that Fraser River Panel take a broader view when establishing management measures. The Canadian National Section believes that we need to consider more than just run size of the target stock when making fishery decisions. While defining "small but acceptable," and "to the extent practicable" is something to be resolved between the National Sections, Chapter 4, section 13(a) also provides guidance to Fraser River Panel deliberations:

> *The Commission staff shall provide the Panel with recommendations for in-season run size and other factors relevant to sound fisheries management decisions.*

Within this context Canada intends to request that the Secretariat prepare an objective report on the circumstances of the 2023 fishery and its consequences, pursuant to Chapter 4, section 13(e). Canada would like this report to include specific recommendations on what information could be used in season to inform the trade-off between a "small but acceptable" incidental mortality and directed harvest, as well as "other factors relevant to sound fisheries management decisions" that might be considered.

Canada remains committed to work collaboratively with our United States partners through the Pacific Salmon Commission process. I appreciate the opportunities we have already had to talk

though some of the issues outlined here, and I look forward to further conversations throughout the post-season process.

Sincerely,



Adam Keizer, Fraser River Panel Chair

Cc. Mark Baltzell, U.S. Co-Chair
Fiona Martens, Pacific Salmon Commission
Catherine Michielsens, Pacific Salmon Commission
National Correspondent, Canadian National Section

Appendix 5: Canadian request for a report on the 2023 season

October 6, 2023

Dear John,

I am writing to follow-up on the most recent Fraser Sockeye and Pink salmon season; in particular, recent in-season decisions within the bilateral Fraser River Panel. As outlined in the attached recent exchanges of correspondence between the Canadian and United States (U.S.) Fraser River Panel Chairs, Canada has identified concerns regarding the process which led to the fishery decisions adopted by the U.S. during the August 18 and August 25 meetings of the Panel.

As outlined in Chapter 4, Section 13 (e) of the Pacific Salmon Treaty (PST), Canada would like to request that the PSC Secretariat prepare a report on the circumstances of the decisions and their consequences. In particular I note the guidance of Chapter 4, section 13 (a): *The Commission staff shall provide the Panel with recommendations for in-season run size and other factors relevant to sound fisheries management decisions*. Canada would like this report to include specific recommendations on what information could be used in season to inform the trade-off between incidental mortality and directed harvest, as well as other factors relevant to sound fisheries management decisions in relation to addressing conservation concerns and achieving escapement objectives.

Our hope is that this report would be presented to the parties at the January 2024 Post-Season Meeting and set the table for a collaborative discussion between Canada and the U.S., as well as the Secretariat, regarding the in-season process and how we can most effectively work together to support the goals and guiding principles of the PST.

Yours sincerely,



Andrew Thomson
Lead Canadian Commissioner
Pacific Salmon Commission

cc. Mr. W. Ron Allen, Commissioner, Pacific Salmon Commission
Bonnie DeJoseph, U.S. National Correspondent
Adam Keizer, Canadian Chair, Fraser River Panel
Cara Fogliato, Canadian National Correspondent

Attachments:

1. Rationale letter for US Fraser Panel Fishery 8-19-2023
2. Rationale letter for US Fraser Panel Fishery 8-25-2023
3. Canada response letter to US rationale letters

Fraser River Panel Bilateral Response to "PSC Secretariat Report – Review of August 18 and 25, 2023 Fraser River Panel fisheries proposals, decisions and subsequent consequences"

Introduction

In response to fishery decisions made at the August 18 and August 25 meetings of the Fraser River Panel (the Panel), the Canadian National Section requested that the Pacific Salmon Commission (PSC) Secretariat prepare a report on the circumstances of the decisions and their consequences. This report, pursuant to Chapter 4, section 13(e) of the Pacific Salmon Treaty (PST), was submitted to the Panel on December 21, 2023. PSC staff presented the report at a January 9, 2023 PSC meeting in Seattle. The Canadian and United States (U.S.) National Sections offer the following comments about the report "Review of August 18 and 25, 2023 Fraser River Panel fisheries proposal, decisions, and subsequent consequences."

Both the Canadian and U.S. Sections appreciate the work of the PSC Secretariat to provide a detailed review to the August 2023 fishery decisions. The Report provides some helpful context and makes some useful recommendations to move forward.

Both National Sections of the Panel recognize the complexities of Fraser River sockeye management and rely on the PST to guide decision-making processes and resolve disagreements between the two National Sections.

Disagreement

In 2023, Canada and the U.S. disagreed on the interpretation of the PST, Chapter 4, section 3(g), in particular reference to "small but acceptable" and "to the extent practical." This resulted in the Panel approving two U.S. pink salmon fishery proposal on August 18 and 25, with the Canadian National Section dissenting.

The U.S. interpretation of Chapter 4 language is that incidental harvest of sockeye, in instances where there is no international sockeye Total Allowable Catch (TAC), is contemplated in section 3 (g). That the use of the term "harvest" is a purposeful acknowledgment of the expectation that bycatch of sockeye, when small enough, is allowed. The U.S. stated in their August 18 rationale letter, supporting retention of incidental sockeye salmon for tribal Ceremonial and Subsistence use, that U.S. tribes have cultural beliefs, enshrined in their traditional laws and fishing regulations that require their fishers to retain all catch, including bycatch, for sampling and to prevent wastage of the resource. Further, the U.S. considered the incidental harvest rate of sockeye small but acceptable in accordance with the PST. Following the August 25 Panel meeting, the US provided a rationale letter and prosecuted a pink-directed fishery Treaty Tribal and All Citizen fishery with no sockeye retention. The U.S. stated that U.S. fisheries would result in a low level of sockeye encounters and fishing-induced mortalities (FIMs) given the sockeye marine run timing and low U.S. fishery effort. The U.S. considered the incidental harvest rate (catch and release) of sockeye small but acceptable in accordance with the PST. Ultimately, the total sockeye mortality from decisions on August 18 and 25 resulted in 3,243 fish (including 872 FIMs), representing a sockeye exploitation rate of 0.19%. The U.S. also interprets the term "to the extent practical", in reference to planning fisheries to minimize incidental harvest of sockeye, to mean the

proposal, as evaluated by the PSC staff, results in very low incidental impacts (for consideration of acceptability) while remaining within available TAC on the target species or management group.

As discussed in our 2023 pre-season meetings, both Parties agree that the definitions depend on the context of a fishery proposal. Two key contextual considerations for the Canadian National Section are (1) stock abundance relative to escapement goals, and (2) that fishery proposals, to the extent practical, are designed to minimize incidental harvest. The Canadian National Section's view of the 2023 fishery decision is summarized:

- Canada's view of "small but acceptable" incidental harvest in the events referenced is that a small amount of Fraser sockeye mortality will occur in U.S. Fraser pink-directed fisheries in the absence of sockeye TAC, and that the parties must negotiate what is considered 'small'.
- When fisheries are designed, that they be designed to the extent practical, to minimize mortality to align with what is deemed acceptable.
- Choices of fishery area, gear, effort, and bycatch release could be considered to minimize impacts to Fraser River sockeye by reducing encounters and/or minimizing mortalities during the development of U.S. Fraser River pink directed fishery proposals These measures should prioritize meeting escapement targets for sockeye salmon, and not incur unnecessary sockeye mortalities.
- On August 18, the U.S. fishery proposal was three days earlier than pre-season planning process identified, there was significant uncertainty in the run size, and the return was experiencing unprecedent migration conditions. Given this Canada felt more conservative approach was necessary.
- In Canada's view, insufficient efforts, to the extent practical, were made to minimize impacts of U.S. pink-directed fisheries on sockeye salmon.
- As a result, the incidental harvest of sockeye salmon, caught and retained in the proposed August 18 fisheries as well as the FIMs in the proposed August 25 fisheries, were not acceptable to Canada.

The Report describes a number of other factors relevant to sound fisheries management decisions (e.g., catchability, effort, release mortality, stock composition), but suggests that the "bottom line" for the recent Panel disagreements is incidental Sockeye mortality, suggesting that this metric integrates across a number of important factors. However this approach presumes an equal weighting across factors and may not fully consider management tradeoffs. This conclusion underpins the Report's subsequent recommendations. However this approach presumes an equal weighting across factors and may not fully consider management tradeoffs.

Moving Forward

The National Sections recognize and appreciate the Staff's development of recommendations that the Panel should consider implementing to reduce the likelihood that Chapter 4, paragraph 13(d)(iii) needs to be initiated by a Party in future fishing seasons.

The National Sections recognize that each annual circumstance is unique and implementing any sort of framework would need to allow for flexibility in management. There is also recognition that the Panel coming to agreement about "small but acceptable" and "to the extent practical" during the pre-season planning process would lessen the likelihood of in-season disputes.

The recommendations may be broadly categorized as (1) means to quantify and evaluate "small but acceptable" [Recommendations 1, 2, 4, 7, 8]; (2) fishery objective refinement and prioritization [3, 5, 6]; and (3) improved monitoring and reporting [10, 11, 12].

The National Sections agree that the annual pre-season planning process should seek agreement about “small but acceptable” and “to the extent practical”, noting that an annual process will be required given that the management context may change significantly from fishing season to season. The Secretariat identified candidate metrics to consider during a pre-season planning process: fixed rates of harvest mortality, variable rates of harvest mortality based on sockeye run size, fixed total mortality rate (including fishing induce mortalities).

In general, the National Sections are in agreement about the benefits of refining fishery objectives and priorities. In general, the National Sections agree with the recommendations regarding improved monitoring and reporting.

The National Sections are committed to documenting a revised pre-season planning process that comprehensively identifies fishery planning scenarios where parties agree on scenario-specific “small but acceptable” sockeye mortality by management unit. The parties will also develop an approach to address in-season fishery proposals that deviate from a pre-season agreement. The Panel will complete this workplan by June 2024.

The National Sections acknowledge that the current chapter language in the PST was drafted at a time when Sockeye scarcity was the exception, not the rule. The differing interpretation of PST language is not a new schism among the parties, but rather a pre-existing divergence that has been exposed by an absence of fish and an uncertain future. Frequent scarcity has left the Panel negotiating fisheries using an agreement where the Parties’ interpretation differs. Given that both Parties' fundamental principles have not changed (namely our priority objective of achieving escapement targets), and given that both Canada and the U.S. have clearly articulated their commitment to work together collaboratively, resolution over the coming year is possible.

APPENDIX J: MEMBERS OF THE FRASER RIVER PANEL TECHNICAL COMMITTEE IN 2023

Canada	United States
S. Decker, Co-Chair *Fisheries and Oceans Canada*	G. Rose, Co-Chair *Northwest Indian Fisheries Commission*
C. Schwindt *Fisheries and Oceans Canada*	A. Seiders *Northwest Indian Fisheries Commission*
M. Staley *First Nations Advisor*	M. Bogaard *Washington Department of Fish and Wildlife*
K. Campbell *First Nations Advisor*	T. Siniscal *National Marine Fisheries Service*

APPENDIX K: STAFF OF THE PACIFIC SALMON COMMISSION IN 2023

EXECUTIVE OFFICE

John Field, Executive Secretary

John Son, Information Technology Manager

Angela Xu, Administrative Assistant

Julie Ehrmantraut, Publications & Web Content Manager

Kim Bartlett, Meeting Planner

Teri Tarita, Librarian, Archivist, and Records Manager

FINANCE AND ADMINISTRATION

Ilinca Manisali, Director of Finance

Witty Lam, Senior Accountant

Koey Lu, Accountant

Sascha Bendt, Grant Program Manager, Restoration & Enhancement Funds

Victor Keong, Program Assistant, Restoration & Enhancement Funds

Christina Langlois, Administrative Assistant, Restoration & Enhancement Funds

FISHERIES MANAGEMENT DIVISION STAFF

Fiona Martens, Director Biologist Programs

Catherine Michielsens, Director Biologist Science

Stock Assessment Group

Merran Hague, Stock Assessment Biologist

Serena Wong, Stock Assessment Assistant

Mark McMillan, Database Manager

Caroline Graham, Chinook Technical Committee Coordinator

Stock Identification Group

Maxine Forrest, Environmental Salmon Biologist

Steve Latham, Manager, Stock Identification

Julie Sellars, Senior Scale Analyst

Catherine Ball, Scale Lab Technician

Angela Phung, Stock Identification Biologist

Dejan Brkic, Assistant Quantitative Fisheries Biologist

Stock Monitoring Group

Eric Taylor, Quantitative Fisheries Biologist

Tosh Sutherland, Manager, Test Fishing Operations

Rachael Hornsby, Manager, Hydroacoustic Fisheries Biologist

Jacqueline Nelitz, Senior Hydroacoustic Technician

Jordan Maguire, Fisheries Technician

Kristen Hayward, Assistant Fisheries Biologist