
**Report of the
Fraser River Panel
to the
Pacific Salmon Commission
on the
2022 Fraser River Sockeye
Salmon Fishing Season**



Prepared by the

**Pacific Salmon Commission
February 2024**

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**REPORT OF THE
FRASER RIVER PANEL
TO THE PACIFIC SALMON COMMISSION
ON THE 2022 FRASER RIVER SOCKEYE
SALMON FISHING SEASON**

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February 2024

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I. EXECUTIVE SUMMARY

The data presented in this report are accurate as at the time of publication. For updates and access to the data, please see our FRP Annual Report App ([FRP Data \(shinyapps.io\)](https://shinyapps.io)). The following paragraphs describe the planning of the 2022 season and the Panel management actions:

Pre-season Planning

1. Pre-season, the median run size forecast (p50 level, Appendix B) was 9,775,000 Fraser River sockeye salmon and there was a one in two chance that the run size would be between 4,662,000 and 20,395,000.
2. Pre-season expectations of migration conditions included a 48% diversion rate for Fraser River sockeye through Johnstone Strait. The Panel adopted the following Area 20 50% migration dates: July 4 for Early Stuart, August 6 for Early Summer, August 10 for Summer, and August 18 for Late-run sockeye.
3. At median (p50) forecast abundance levels, pre-season spawning escapement goals were 105,000 Early Stuart, 789,600 Early Summer, 2,201,300 Summer and 1,844,000 Late-run sockeye for a total of 4,939,900 sockeye salmon (Table 1). These goals were established by applying Canada's Spawning Escapement Plan (Appendix B) to the median forecasted run sizes for each management group.
4. Despite substantial remediation work, Big Bar was still expected to negatively impact the upstream migration of Early Stuart and Early Summer run sockeye in 2022. In case migration was impeded, the plan was to provide fish "trap and transport", enhancement and monitoring operations.
5. Management Adjustments (MAs) of 105,000 Early Stuart, 465,900 Early Summer, 88,100 Summer-run and 405,700 Late-run sockeye were added to the spawning escapement targets to increase the likelihood of achieving the targets (Appendix F, Table F3). Although a MA was adopted for Early Stuart, the spawning escapement target (SET) was its entire run size at the median forecast abundance level.
6. Based on the median forecasted abundances and agreed deductions, there was a projected Total Allowable Catch (TAC) of 3,401,100 Fraser River sockeye salmon of which 16.5% (560,700) was allocated to the U.S.
7. Harvest constraints on both Early Summer and Late-run management groups were expected to prevent either country from accessing sufficient Summer run sockeye to reach their TAC limit. There were also concerns raised by Canada regarding the amount of incidental harvest of Early Summer sockeye based on the pre-season fishing plan.
8. The Panel adopted the 2022 Management Plan Principles and Constraints and Regulations, and 2022 regulations (Appendices C, D).

In-season Management Considerations

9. The in-season marine migration timing (Figure 3) was later than pre-season expectations for Early Stuart (2 days later) and Summer run (5 days later) and earlier than expected for Early Summer (7 days earlier) and Late run (2 days earlier) sockeye.
10. The overall Johnstone Strait diversion rate (Figure 4) for Fraser River sockeye was 34% compared to the pre-season forecast of 48%.
11. With the exception of Early Stuart, returns for Fraser sockeye salmon were below the median pre-season forecasts: Early Stuart run: 132% above median forecast, Early Summer run: 62% below median forecast, Summer run: 14% below median forecast, Late run: 42% below median forecast. The number of returning Early Stuart sockeye was above the p75 run size forecast, and for Early Summer run it was between the p10 and p25 forecast. For Summer and Late run groups, the number of returning sockeye were between the p25 and p50 run size forecasts.

12. In-season, there was uncertainty regarding the extent to which low returns and early timing of the Early Summer run indicated low returns for Summer-run and Late-run sockeye. On August 18, 2022, Canada disagreed with both the run size recommendations for Summer and Late run sockeye put forward by PSC staff and the resulting U.S. fisheries proposals. This resulted in the United States prosecuting a sockeye fishery that Canada objected to under the provisions of Annex IV, Chapter 4, paragraph 13(d)(iii)¹.
13. Early in the season, extremely high discharge caused migration challenges within the Lower Fraser River for Early Stuart and early arriving Early Summer run sockeye. The high water discharge slowed down and hampered the upstream migration to the Big Bar slide location. Discharge levels decreased fairly quickly in early July and at Big Bar, there were no obvious impediments during the migration of later timed Early Summer and Summer-run sockeye salmon.
14. Fraser River temperatures were below historical average in July and through mid-August and then exceeded the maximum temperature in late August through mid-September (Figure 7) which may have negatively impacted the survival of Summer and Late run sockeye.

Run Size, Catch, and Escapement

15. Returns of adult Fraser sockeye totalled 6,933,200 fish (Table 7) which was 36% less than the total return of 10,864,000 fish in the primary brood year (2018). This is the lowest return on this cycle line since 1970. Divided into management groups, adult returns totalled 244,200 Early Stuart, 710,100 Early Summer-run, 3,856,300 Summer-run and 2,122,500 Late-run sockeye.
16. Despite the better than expected return for Early Stuart, it was managed using a low abundance exploitation rate (LAER) of 10%, as was the Early Summer run at 20%. Summer and Late run returns were less abundant than forecast and to account for the in-season migration conditions and ensure spawning escapement targets would be met, the Panel adopted a larger Management Adjustment for the Summer run in-season.
17. Catches of Fraser River sockeye salmon in all fisheries totalled 1,522,200 fish, including 1,128,800 fish caught by Canada, 352,300 fish caught by the U.S. (Washington) and 41,100 fish caught by test fisheries (Table 6). The Canadian catch was a mix of commercial, 230,100 (Table 8), First Nations Catch, 873,400, and non-commercial catch, 25,400, which included 8,300 'other' catch (unauthorized directed retention or unauthorized bycatch retention in fisheries directed at other species). In Washington, commercial catches totalled 341,300 Fraser sockeye (Table 9), mostly caught in Treaty Tribal fisheries (265,800). In addition, 11,000 sockeye were caught in non-commercial ceremonial and subsistence Treaty Tribal fisheries. The catch for the Alaska District 104 fishery was 73,000 fish. The overall harvest rate (including Alaska catch) was 23% of the run (Figure 9).
18. Low returns for Early Summer and Late run combined with migration challenges and Late run assessment uncertainty impacted fishing opportunities in 2022.
19. DFO's near-final estimates of spawning escapement to streams in the Fraser River watershed totalled 3,511,900 adult sockeye and were below the cycle line averages for Early Stuart and Late run but above the cycle line averages for Early Summer and Summer run (Figure 11). The total escapement was 14% less than the brood year escapement of 4,100,200 adults. There were 1,704,200 effective female spawners in the Fraser watershed, representing an overall spawning success of 93%.

Achievement of Objectives

20. 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.
21. Management decisions are based on spawning escapement targets, which are represented in-season by potential spawning escapement targets (i.e., spawning escapement targets plus MAs). In-season estimates of potential escapement (i.e., Mission escapement minus all catch

¹ Pacific Salmon Treaty as modified through January 2020.

- above Mission) were 18% above target across all Fraser sockeye stocks, 2% and 12% below target for Early Stuart and Early Summer run sockeye, respectively, and 31% and 14% over target for Summer and Late run, respectively (Table 10).
22. Post-season estimates of spawner abundance totalled 3,511,900 adults which is 3% below the post season target. Across management groups, the extent potential escapement targets were met varied considerably: Early Stuart sockeye (87% under), Early Summer-run (47% over), Summer-run (2% over) and Late-run sockeye (13% under) (Table 11). The exploitation rate for Early Stuart and Early Summer run management groups was 2% and 12%, respectively, which was less than the LAER of 10 and 20% respectively (Table 7).
 23. There was International TAC (Total Allowable Catch) of 1,981,400 Fraser sockeye (Table 12), based on the calculation method set out in Annex IV, Chapter 4 of the Pacific Salmon Treaty. The Washington catch of 352,300 Fraser sockeye mostly occurred between August 18 and August 22 (Figure 12) and caused the U.S. to catch 17.8% instead of 16.5% of the TAC, exceeding its share by 25,800 sockeye. The total Canadian catch of 1,128,800 Fraser sockeye was a combination of commercial, First Nations and non-commercial catch and was 55% of the Canadian share of TAC + AFE. In these calculations, the TAC is based on the TAC on the date of the last in-season Panel meeting (September 28, 2022), while catches are post-season estimates.
 24. In terms of domestic U.S. allocation objectives for Fraser sockeye, U.S. Tribal fishers were 55,800 fish above their share whereas All Citizen fishers were 30,000 below their share of the U.S. TAC (Table 13).
 25. There was a by-catch of 240 non-Fraser sockeye salmon and 100 non-Fraser pink salmon in commercial net fisheries regulated by the Fraser River Panel (Table 14). Catches of other Fraser and non-Fraser salmon species included 8,110 Chinook, 1,230 coho, and 140 chum.

Allocation Status

26. As the U.S. payback of 470 Fraser River sockeye accrued during the 2019 pink directed fisheries was considered paid back, and no additional payback was accrued in 2022 based on the run size estimates adopted on August 18, there was no payback of Fraser River sockeye to be carried forward to 2023 (Table 15).

Post-season Review

27. On August 18, 2022, the United States prosecuted a sockeye fishery that Canada objected to under the provisions of Annex IV, Chapter 4, paragraph 13(d)(iii).
28. Pursuant to the same paragraph, the United States provided a rationale for the fishery via correspondence to the Panel's Canadian vice-chair on August 19, 2022 (U.S. rationale, Appendix H).
29. On October 14, 2022, Canada corresponded with the Executive Secretary (Canadian response, Appendix H) requesting an objective report on the circumstances of the fishery and its consequences pursuant to Chapter 4, paragraph 13(e).
30. A report (Appendix H) prepared by PSC staff was submitted to the Panel December 2022 and reviewed at the PSC January post-season meeting. The report contained 13 recommendations to be considered by the Fraser River Panel.
31. The response of the Panel (Appendix I) provided the perspective of both countries as well as a bilateral response to the recommendations.

II. FRASER RIVER PANEL

In 2022, the Panel operated under the terms of Annex IV, Chapter 4 of the Pacific Salmon Treaty between Canada and the United States (U.S.)². The Fraser River Panel was responsible for in-season management of fisheries that target Fraser River sockeye salmon within the Panel Area (Figure 1), including 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 in south coast areas 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 by-catch in fisheries directed at Fraser 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 and assumptions. However, the Panel typically determines the actual pattern of fishery openings based on in-season assessments by PSC 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 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.

² Pacific Salmon Treaty as modified through January 2020.

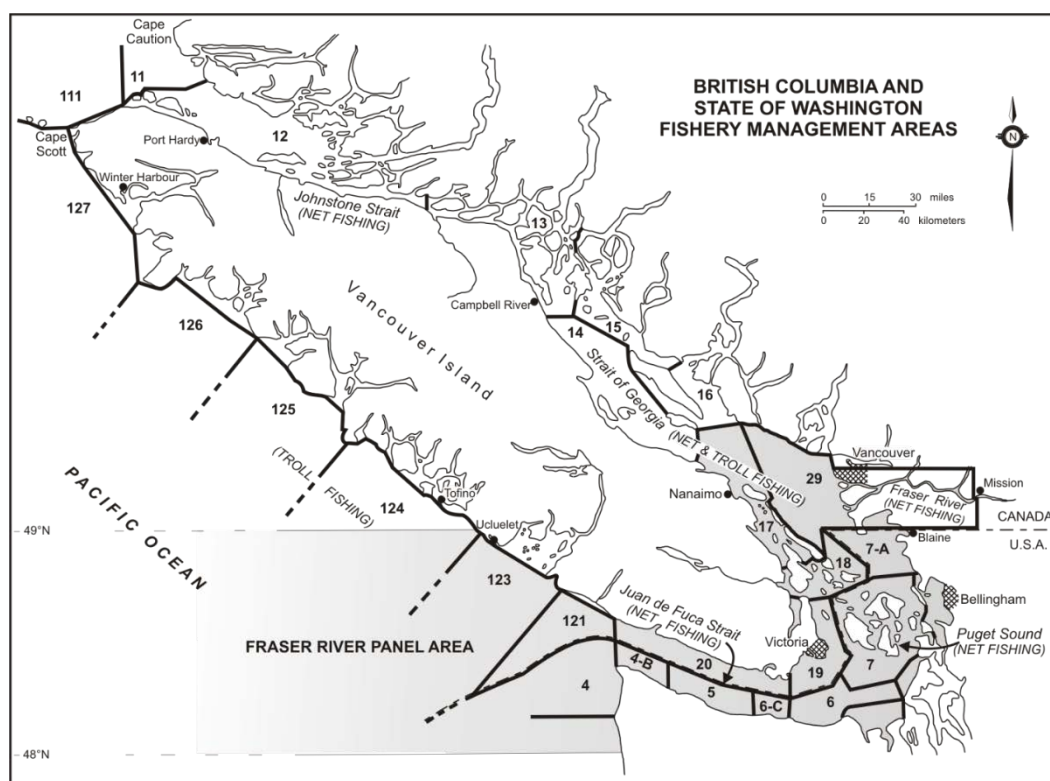


Figure 1. Fishery management areas in the Fraser River Panel Area and south coast waters.

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 salmon directed fisheries were developed by the Panel using the Fishery Planning Model^{3,4}, 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

³ Cave, J.D. and W.J. Gazey. 1994. A pre-season simulation model for fisheries on Fraser River sockeye salmon (*Oncorhynchus nerka*). Can. J. Fish. Aquat. Sci. 51(7): 1535-1549.

⁴ 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.

Georgia, and management adjustments (MAs), as well as objectives for spawning escapement and catch allocation and test fishery deductions.

Both countries evaluated fishing plans directed at catching Fraser River sockeye. Assuming the median run size estimate (p50 or 50th percentile), there was available harvest and directed fisheries targeting Early Summer, Summer and Late-run management groups. Neither country achieved their target catch due to harvest constraints associated with the relatively low Early Summer-run TAC. The U.S. was also constrained by the assumed diversion rate, which reduced access to the available Late-run TAC. The U.S. fishing plan resulted in a modelled sockeye catch of 549,600 or 98% of their 560,700 allocation. While the U.S. came within a few thousand fish of their TAC, there were concerns raised that the modelled catch of Early Summer-run fish exceeded the Treaty's "small but acceptable" clause⁵. Planning for early-timed fisheries in Canada were also constrained by rolling window closures and a low abundance exploitation rate (LAER) of 10% assigned to the Early Stuart run, while access to Late-run catch was limited due to domestic conservation objectives applied to the Cultus Lake conservation unit. The LAER is applied to accommodate small amounts of by-catch for management groups with little or no TAC, as detailed in the Integrated Fisheries Management Plan⁶. The Canadian fishing plan resulted in a modelled sockeye catch of 2,171,500, or 67% of the 3,240,500 sockeye available for harvest by Canada.

Alternative model runs explored the sensitivity of fishing plans to alternative salmon run size estimates and different diversion rates. One alternative assumed a sockeye salmon run size at the pre-season p25 (25th percentile) forecast, which resulted in the activation of the LAER for the Late-run management group. Prior to receiving diversion rate forecasts from Canada, initial p25 and p50 model runs assumed 67% of sockeye would migrate through the northern Johnstone Strait route, reducing the availability of later-timed sockeye management groups in U.S. waters.

The 2022 run-size forecast for Fraser River sockeye salmon was produced by Canada using a variety of stock-recruit models with data up until the 2018 brood year (2019 brood year for Harrison). A new suite of forecast models was considered based on the completion of an updated retrospective analysis conducted by DFO. Canada presented the Panel with run-size forecasts for each management group and component stocks 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 above or below the forecast value. For fisheries planning purposes, the Panel used the median (i.e., p50) run size forecast of 9.8 million Fraser River sockeye salmon as the "base case" scenario. The Panel also explored two alternative models, (1) assuming a sockeye salmon run size corresponding to the 25th percentile of the distribution of the forecasted run size (p25: 4.6 million), and (2) assuming a historically-based diversion rate of 67% compared to the forecasted diversion rate of 48%, which was the average of two alternative diversion rates of 51% and 46%, derived by DFO using a combination of current velocities and sea surface temperatures⁷. The diversion rate reflects the proportion of Fraser River sockeye salmon migrating through Johnstone Strait instead of Juan de Fuca Strait (i.e., Johnstone Strait diversion rate, Figure 2)

Canada used the "Fraser River Sockeye Spawning Initiative" (FRSSI) model in combination with pre-season stakeholder consultations to establish escapement goals for 2022. These are documented in the Pacific Region Integrated Fisheries Management Plan (IFMP). 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

⁵ 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/>)

⁶ Fisheries and Oceans Canada. 2022. Southern Salmon Integrated Fisheries Management Plan 2022/23. 22-2202: 605p.

⁷ 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.

resulting pre-season escapement targets for sockeye at the p50 run size levels by management group were: Early Stuart – 105,000; Early Summer run – 789,600; Summer run– 2,201,300; and Late run – 1,844,000.

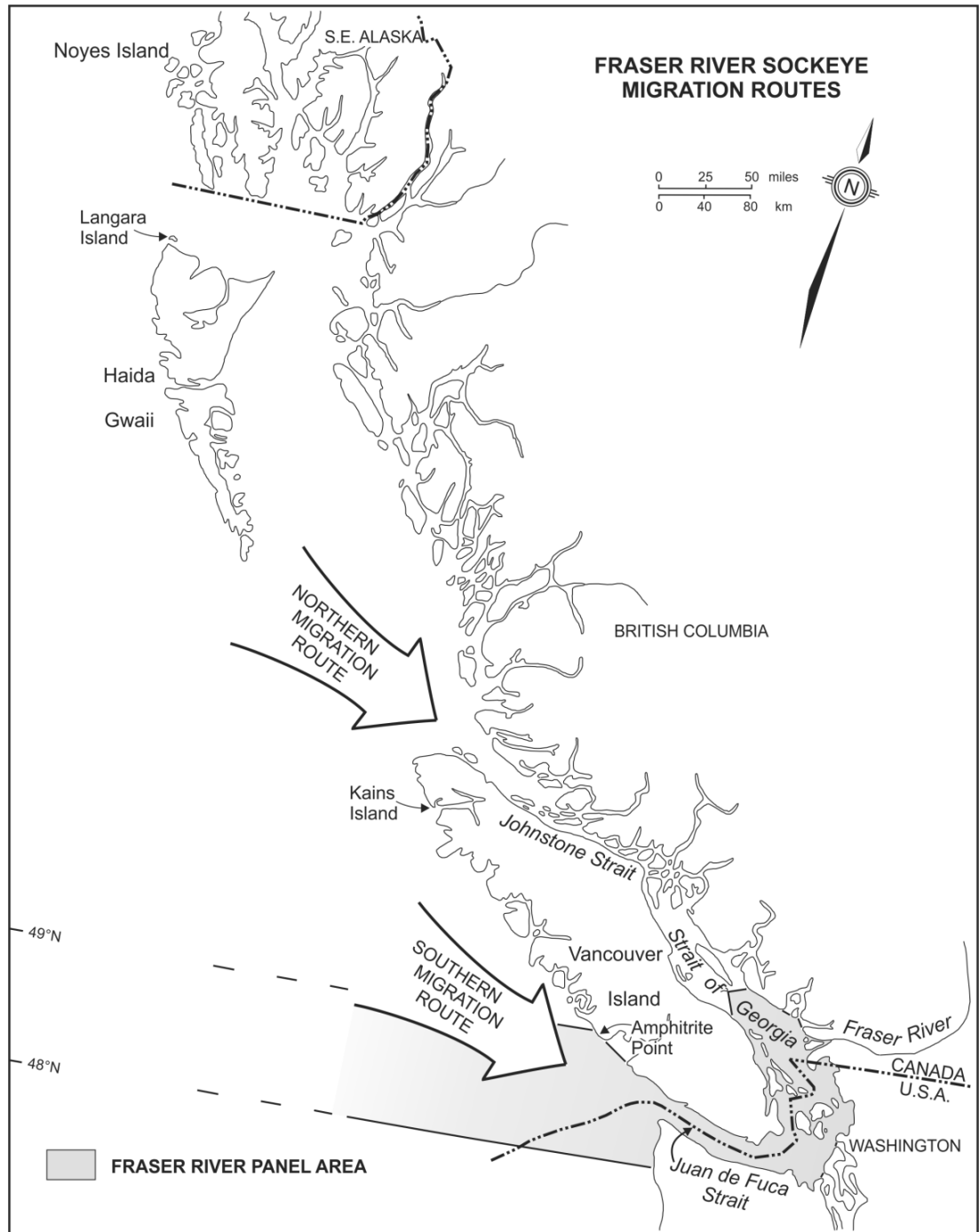


Figure 2. The northern (Johnstone Strait) and southern (Juan de Fuca Strait) routes for sockeye and pink salmon migration to the Fraser River.

Pre-season fisheries management planning was based on assumptions about 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. DFO's oceanographic models^{Error! Bookmark not defined.} generated timing forecasts of July 3 or July 6 for the Early Stuart run and August 14 for the Chilko run. Timing for other stock groups in the Planning Model were generated by adjusting historical medians by the difference between the historical median Chilko timing for all years excluding the 2016 cycle line and the 2018 Chilko timing forecast. The Panel adopted the resulting historical timing estimates of July 4 for the Early Stuart run, August 6 for the Early Summer run, August 10 for the Summer run and August 18 for the Late run. Figure 3 illustrates the distribution of daily abundances by management group given the pre-season assumptions of Area 20 timing and total run size.

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 21-day delay for the Late-run, equivalent to the median delay on this cycle-line over all years. For planning purposes, the model assumed 80% of the non-Birkenhead Late-run group would delay in the Strait of Georgia and would migrate upstream with a peak migration date of September 20. For the overall Late run group, this resulted in 50% of the run migrating upstream by September 17 and corresponded to a 21-day migration delay assuming an 8-day migration time between Area 20 and Mission without holding. The model also assumed 40% of Harrison sockeye salmon would delay in the Strait of Georgia prior to the peak of migrating upstream on September 20, the same upstream timing as the delaying Late-run stocks. For the entire Harrison stock group, this resulted in an August 22 Mission 50% date and assumed 8-days of migration delay.

DFO's Environmental Watch (E-Watch) Program provided the Panel with long-range (3-month) projections of Fraser River temperature and discharge conditions. The Fraser River basin index was 144% above normal on June 1, increasing from 129% on May 15 ([Snow Conditions & Water Supply Bulletin - Province of British Columbia \(gov.bc.ca\)](#)). Due to delayed snowmelt, flood risk remained high. The long-range forecast predicted above average discharge for the early summer period and below average to average lower river water temperature for the summer. The forecast was for above average discharge and below average to average water temperature in the Fraser River. For 2022, the Panel chose to adopt the proportional management adjustments (pMAs) (see Table F3) based on the best pDBE forecast method identified by the retrospective analysis of the pre-season pDBE approaches (Appendix F, Table F5). The environmental forecast was used to populate the best performing methods to predict the proportional difference between estimates (pDBE) as identified by a retrospective analysis. This prediction determined how many additional sockeye should be allowed to escape to achieve spawning escapement objectives⁸. Additional consideration was given to the potential impact of the Big Bar slide ([Big Bar landslide response information bulletins | Pacific Region | Fisheries and Oceans Canada \(dfo-mpo.gc.ca\)](#)). Due to the delayed snowmelt, there was some concern regarding the impact of high-water events at the Big Bar slide on Early Stuart and early migrating Early Summer run. If discharge levels were greater than the passage threshold at the Big Bar slide (3,650 m³/s), sockeye migration was expected to be impacted.

For 2022, the Panel agreed to forego the weighted pDBE approach for Early Summer, Summer and Late run given the low forecasted relative abundances of Pitt and Chilliwack fish in the Early Summer-run aggregate, Harrison fish in the Summer-run aggregate and Birkenhead fish in the Late-run aggregate. The Panel adopted a pMA for the Early Stuart run (pMA=1.00; MA=105,000 fish), Early Summer-run aggregate (pMA=0.59; MA=465,900 fish), Summer run

⁸ 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

aggregate (pMA=0.04; MA=88,100 fish) and Late-run aggregate (pMA=0.22; MA=405,700 fish) (Table 1).

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 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)⁹, Sakinaw and other inside non-Fraser sockeye salmon stocks, 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.

As 2022 was expected to have a high returning abundance of Fraser River sockeye, additional test fisheries to supplement the core assessment program were scheduled. These were the Area 13 purse seine, the Areas 4B, 5 gill net, and the Gulf troll in Area 29. In 2022, an experimental gill net test fishery in the lower Fraser River was continued for the second year at the Brownsville Bar site and operated from mid-July to mid-August with costs covered by the Southern Endowment Fund (SEF)¹⁰. The final year of an SEF project evaluating the use of an Alaska twist gill net was also scheduled to take place in Area 12 at the Round Island location. 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^{11,12}. Approximately one-half of the cost of the proposed test fisheries (a total program cost of \$ 1,674,000), 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, with the exception of the SEF projects, 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.

Due to the uncertainty in the forecast sockeye abundance, the total non-discretionary catch (40,400) for sockeye salmon was estimated using the historical relationship between non-discretionary catch and sockeye run size. The 2022 season was the first time this catch estimation method was used in favour of the previous estimation method¹³. 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.

Calculations of TACs and international harvest shares for Fraser sockeye salmon were based on Annex IV, Chapter 4 of the Pacific Salmon Treaty. The pre-season sockeye TAC for international sharing was 3,401,000 (Table 1), of which the U.S. (Washington) share was 16.5% or 560,700 fish after the removal of a U.S. payback of 470 carried over from previous years. Treaty Tribal fisheries were allocated 67.7% of the U.S. TAC and All Citizen fisheries the remaining 32.3%. Adding the remaining TAC balance to the 400,000 Aboriginal Fishery Exemption (AFE) resulted in 3,240,500 sockeye available for harvest by Canada. Commercial pre-season catch targets in Canada totalled 2,048,000 sockeye; Canadian non-commercial catch targets totalled 1,192,400, including 784,000 fish for in-river First Nations and 266,800 fish for marine First Nations, plus projected recreational catches of 79,800 fish in the Fraser River and 61,800 fish

⁹ 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.

¹⁰ Sutherland, T., Baltzell, M., Jantz, L., and A. Fisher. 2023. Lower Fraser River Gillnet Test Fishery Site Evaluation. SEF Final Report.

¹¹ Pacific Salmon Commission Test Fishing Policy. Feb. 10, 2021. Pacific Salmon Commission

¹² Rule 25: Test Fishing Revolving Fund. Pacific Salmon Commission. PSC Bylaws: Chapter IX

¹³ Taylor, E. 2022. Test fishing catch forecasts. 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, 36-37 p.

in marine areas. In Canadian commercial fisheries, Area B purse seine was allocated 48.0%, Area D gill net was allocated 21.4%, Area E gill net was allocated 24.8%, Area G troll was allocated 1.0%, and Area H troll was allocated 4.8%.

Pre-season, the Fraser River Panel was presented one planning scenario at the median forecast that included variations in assumed sockeye diversion rate (historical estimate versus DFO pre-season forecast) and adopted a Base Case Planning Model assuming the median run size forecast and the average diversion rate forecast (48%) produced by DFO. Canada and the U.S. developed a pre-season management plan under the “base case” conditions which included the “2022 Management Plan Principles and Constraints” and “2022 Regulations” (Appendices C & D). In the pre-season plan, Areas 4B,5,6C Treaty Tribal fisheries were the first potential fisheries directed at Fraser River sockeye salmon commencing on July 31 and operating until August 24. The first Canadian marine fisheries commenced on August 1 in Juan de Fuca and Johnstone Strait FSC fisheries. For pre-season planning, a 10% LAER for Early Stuart, a moving window closure for fisheries directed at Early Stuart sockeye, as well as area closures to protect Nimpkish sockeye and gear and timing restrictions to protect Sakinaw sockeye, constrained fishery openings during earlier dates in the pre-season plan. In addition, Canada planned to manage Cultus Lake sockeye consistent with the Late-run allowable exploitation rate as determined in-season.

B. In-season Management

In 2022, all sockeye salmon management groups returned at run sizes that were below the median pre-season forecasts, and with marine timing slightly earlier than forecast, except for Early Stuart which returned above pre-season forecast and two days later than forecast (Figure 3).

The Fraser River Panel convened 22 times between July 12, 2022 and September 20, 2022 to discuss run status and enact in-season orders (Appendix E) to regulate fisheries directed at Fraser River sockeye 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 10 - 16, 2022:

The first in-season Panel meeting took place on Tuesday, July 12. Due to the higher than average snowpack remaining, discharge was higher than average for the time of year. On July 14, the Fraser River water discharge at Hope was about $8,819 \text{ m}^3 \cdot \text{s}^{-1}$, which was approximately 61% greater than average for this date and the temperature was 1.8°C less than average at 14.9°C . While the high discharge did not seem to impede sockeye reaching the Mission hydroacoustic site, there were signs that sockeye salmon were experiencing migration challenges further upstream and pooling in areas below Hells Gate. 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 (105,000 sockeye) and likely exceed the p75 forecast level of 172,000, given that 170,000 Early Stuart sockeye had been accounted for in catch plus escapement by July 15. The Qualark hydroacoustics program was delayed until July 15 due to high discharge levels.

As of July 14, 159 salmon had been observed 40 km upstream of Big Bar at Churn Creek but these were likely all Chinook salmon and not sockeye salmon. To date, 166 tags had been applied to sockeye at the Matsqui fishwheel and two sockeye had been tagged at the Lillooet fishwheel, which would allow to evaluate migration success past Hells Gate and Big Bar. Given the migration challenges experienced by Early Stuart, a total of 175 Early Stuart sockeye had been collected for broodstock at the Matsqui fishwheel, with the target being 270 sockeye.

July 17 – 23, 2022:

Approximately 213,300 Early Stuart sockeye had passed by Mission on July 21 and Early Stuart migration through marine approach areas was winding down. Associated run size estimates were much higher than the median forecast of 105,000 sockeye and at the meeting on Tuesday the Panel adopted an Early Stuart in-season run size of 230,000 with an associated Area 20 marine timing of July 6. The adopted run size exceeded the p75 forecast of 172,000 while the timing was two days later than predicted preseason.

Despite this better than forecast return, river conditions for Early Stuart migration were extremely challenging with discharge levels at Hope exceeding $8,000 \text{ m}^3\cdot\text{s}^{-1}$. Migration past the Yale rapids and Hells Gate proved particularly challenging. This resulted in salmon needing substantially more time to migrate upstream and many salmon were observed pooling in areas of the lower Fraser River. At Tuesday's meeting the Panel therefore also adopted a proportional Management Adjustment of 13.29, indicating that 93% of the Early Stuart run was not expected to make it to the spawning grounds. This estimate excluded additional passage challenges associated with Big Bar.

On July 21, the Fraser River water discharge at Hope had decreased to $7,479 \text{ m}^3\cdot\text{s}^{-1}$, which was still 52% greater than average for this date but allowed more sockeye to pass Hells Gate and further up the Fraser River. The temperature of the Fraser River at Hope on July 21 remained benign at 15.6°C and was 1.8°C less than average for this date. At the Friday meeting, the first reports were received of sockeye reaching and passing the Big Bar area using the nature-like fishway. Migration past the slide area was still challenging with tagging information indicating both sockeye and Chinook salmon had to make multiple attempts at passage and unsuccessful passage still occurred at Big Bar discharge levels between $4,300$ to $5,000 \text{ m}^3\cdot\text{s}^{-1}$. On Friday, a total of 645 salmon had been detected at the Churn sonar site above Big Bar, of which 212 were estimated to be sockeye based on their hydroacoustic lengths.

July 24 – 30, 2022:

Approximately 232,100 Early Stuart sockeye had been accounted for in catch plus escapement past Mission. The estimated escapement of Early Summer-run sockeye past Mission through July 28 was 169,000 fish. Marine purse seine test fisheries started in Areas 20, 12 and 13 this week and catches substantially increased in Area 20, remained relatively low in Area 12 and were variable but showed signs of increasing in Area 13. Total catch plus escapement to date equalled 442,800 sockeye which was in line with expectations for this date.

The very high discharge conditions observed in the Fraser River over the last several weeks had decreased and salmon migration speeds had almost returned to normal. On July 28, the Fraser River water discharge at Hope was about $6,050 \text{ m}^3\cdot\text{s}^{-1}$, which was still 33% greater than average for this date. The temperature of the Fraser River at Qualark on July 28 was 17.7°C , which was average for this date.

Salmon passage through Big Bar continued and it was estimated that 7,825 sockeye salmon had passed to date. Most passage through the Big Bar site, 65%-70%, was still assumed to be Chinook salmon. Given that discharge levels were no longer impeding natural upstream migration, the fishwheel below Big Bar was no longer running. Tagging fish at Matsqui and Big Bar fishwheels had also completed for the season but tagging at the Lillooet fishwheel would continue.

In the U.S., the Panel opened a Treaty Tribal fishery in Areas 4B, 5, and 6C.

July 31 – August 6, 2022:

Approximately 241,000 Early Stuart sockeye had been accounted for in catch plus escapement. The associated timing of Early Stuart sockeye of July 6 was used in combination with the timing for Lake Washington (July 13) to produce an updated timing estimate for Chilko of August 13 using a multiple regression analysis and indicated later timing than assumed preseason (August 10).

The estimated escapement of Early Summer-run sockeye past Mission through August 4 was 271,500 fish. Based on data collected to date and the later timing of Early Stuart, the timing of Early Thompson was expected to be later than assumed pre-season (August 8). Assuming a 3 day later timing for Early Thompson (August 11), abundances for this component of the Early Summer run were tracking the p25 forecast of 605,000. It was still considered too early to recommend an Early Summer-run run size.

Total catch plus escapement to date for Summer-run sockeye equalled 221,700 sockeye through August 4 which was below expectations for this date. Assuming a 3 day later timing of August 13 instead of August 10, daily Summer-run abundances corresponded with expectations. The majority of sockeye en route to the Fraser River continued to predominately migrate through the Juan de Fuca Strait rather than through Johnstone Strait and the 5-day average diversion rate was 20%.

On August 4, the Fraser River water discharge at Hope was $5,282 \text{ m}^3\cdot\text{s}^{-1}$, and was not expected to impede salmon migration, while still being 33% greater than average for this date. The temperature of the Fraser River at Qualark had increased to the average temperature for this time of year, 18.7°C . At Big Bar, natural salmon passage continued, and it was estimated that 103,143 salmon had passed to date. At this time, most passage through the Big Bar site was assumed to be sockeye salmon.

In the U.S., the Panel approved the extension of the Treaty Tribal fishery in Areas 4B, 5, and 6C. On August 5, catches totaled 24,000 Fraser sockeye, with about 5,000 caught by the U.S, 6,000 caught by Canada, and 13,000 caught in the various test fisheries.

August 7 – August 13, 2022:

The total accounted run to date was 1,595,900 sockeye salmon, consisting of 243,900 Early Stuart, 463,400 Early Summer-, 828,600 Summer- and 60,000 Late-run sockeye.

At the Panel meeting on Tuesday, the Panel adopted an Early Stuart run size of 241,000 with an associated 50% marine timing in Area 20 of July 6. They also adopted an Early Summer-run run size of 764,000 with an associated 50% marine timing in Area 20 of August 5. Further updates were made at the Friday meeting when the Panel adopted an Early Stuart run size of 244,000 with July 6 timing as well as an Early Summer-run run size of 792,000 with August 4 timing. For Early Stuart, this implied an above average productivity, instead of the very low productivity experienced in recent years, and for Early Summer run, it implied a low productivity similar to recent years. It was still too early to make any assessments for Summer-run run size, but it appeared to be tracking near the p50 forecast level of 4,403,000. The five-day average sockeye diversion rate through Johnstone Strait remained low at 16%.

Discharge remained high throughout the watershed for the time of year. On August 11, the Fraser River water discharge at Hope was about $4,194 \text{ m}^3\cdot\text{s}^{-1}$, which was approximately 19% greater than average for this date. The temperature of the Fraser River at Hope on August 11 was 18.9°C , which is 0.4°C greater than average for this date. For Early Summer run, the 19-day model predicted an expected DBE of -43% assuming a timing of August 5. Since pre-season retrospective analyses revealed the All-years median, -37% (1977-2021), to be the best performing in-season model, no recommendations were made to update the pDBE for Early Summer run.

Natural salmon passage through Big Bar continued and it was estimated that 311,599 salmon had passed to date. As of August 4, almost all passage through the Big Bar site was assumed to be sockeye salmon.

In the U.S., the Panel approved the extension of the Treaty Tribal fishery in Areas 4B, 5, and 6C and opened a Treaty Tribal fishery in Areas 6, 7 and 7A and an All Citizen fishery in Area 7. On August 12, catches totaled 116,000 Fraser sockeye, with 83,000 caught by Canada, 13,000 caught by the U.S and 20,000 caught in the various test fisheries. These catches represented about 7% of the 1.6 million accounted run-to-date.

August 14-20, 2022:

The marine gillnets were terminated as scheduled, with the last fishing day occurring on August 14 and 16, in Area 12 and 20 respectively. It was also the last week for the Brownsville

Bar SEF test fishery which terminated as planned on August 18. In addition, the Panel decided to terminate the Area 13 test fishery on August 20, which was earlier than the scheduled date of September 11. In the purse seine test fisheries, catches had increased over that last week, especially in Area 12, with a significant drop on the most recent day, while in Area 20 test catches increased in the last two days. With the majority of sockeye migration through the Johnstone Strait route, the current 5-day average diversion rate was 62%.

The total accounted run to date in catch and escapement was 2,676,600 sockeye salmon, consisting of 244,200 Early Stuart, 540,900 Early Summer-, 1,655,900 Summer- and 235,600 Late-run sockeye. At the Panel meeting on Tuesday, the Panel adopted an Early Summer-run run size of 614,000 with an associated 50% marine timing in Area 20 of July 30. On August 18, catches totaled 458,000 Fraser sockeye, with 292,000 caught by Canada, 139,000 caught by the U.S. and 27,000 caught in the various test fisheries.

At the combined Panel and Technical Committee on Thursday August 18, there was still considerable uncertainty associated with the run size estimates and timing for both Summer and Late run sockeye. Run size estimates based on traditional run size models indicated that the peak of the Summer and Late runs had not yet been observed as both test fishing data and daily reconstructed abundances based on hydroacoustic data still indicated increasing trends. The resulting estimates for Summer (3,762,000) and Late run (1,206,000) using traditional run size estimation methods were therefore considered potential underestimates, as these methods rely on observing the peak of the run. For Late run it had been possible to generate alternative run size estimates using smolt data from 2020 for Late Shuswap/Portage and Early Thompson in combination with the in-season run size estimate of Early Thompson to generate an in-season run size estimate for Late Shuswap/Portage of 928,000. The main concern was the quality of this estimate given the limited sample size (325) in comparison to the samples collected in 2012 (3,653) and 2016 (2,478). A range of alternative Late run estimates of various quality confirmed the need to reduce the run size for Late run but it remained unclear to what extent. For Late run, PSC staff recommended a run size of 2,000,000 with an associated Area 20 timing of August 18. This timing estimate matched the preseason assumed timing as well as the Late Shuswap/Portage timing prediction based on observed timing for Early Stuart (July 6) and Early Thompson (August 4). For Summer run, PSC staff recommended a run size of 4,403,000 (p50 forecast abundance level) with an associated Area 20 timing of August 15, given the lack of evidence that the p50 forecast could not be reached as daily abundances were tracking close to the forecasted abundances, and the peak of the Summer run had not yet been observed. Staff also recommended an updated Early Summer-run run size of 627,000 with an associated 50% marine timing in Area 20 of July 31.

The U.S. agreed with these run size recommendations, but Canada did not. Canada felt these run sizes were too optimistic and proposed a run size for the Summer run of 3,762,000, based on the PSC in-season reconstruction model estimate, and a run size for the Late run of 1,600,000 which was the p25 pre-season forecast and approximately the mid-point of all model estimates provided by PSC staff. As acceptance of the Staff recommendation only requires approval of one of the National Sections, the PSC staff recommendations were accepted.

Following the adoption of the run size estimates, the U.S. proposed an extension of the Treaty Tribal fishery in Areas 4B, 5, and 6C, a Treaty Tribal fishery in Areas 6,7 and 7A and an All Citizen fishery in Areas 7 and 7A. The catch evaluation by PSC staff of these fisheries indicated there was enough U.S. TAC for these fisheries to be prosecuted. However, it was noted that the U.S. had already exceeded their Early Summer run TAC by 12,810, and staff estimated the proposed fisheries would add about 3,600 Early Summer run sockeye to U.S. catches. Canada strongly opposed the U.S. fisheries proposal citing concerns about run sizes for Early Summer run, Summer run and Late run. Canada noted that for Early Summer run the U.S. had already exceeded the TAC on that management group. Staff noted that if run sizes were reduced as proposed by Canada, predicted catches of these fisheries would not exceed the total U.S. TAC. The U.S. decided to move forward with their fishery plans. As the U.S. opposed Canada's opinions, the U.S. provided a letter of rationale to the Panel for the proposed fishery on August 19, preceding the start of their fishery.

On August 18, the Fraser River water discharge at Hope was about $3,749 \text{ m}^3\cdot\text{s}^{-1}$ which is approximately 22% greater than average for this date. The temperature of the Fraser River at

Qualark on August 18 was 19.9°C, which is 1.3°C greater than average for this date. For Summer run, the 19-day model predicted a DBE of -21% assuming an Area 20 timing of August 13 which was more negative than the pre-season value of -4%. Based on the retrospective analysis evaluation of 2010-2021 for Summer run, the best performing in-season model was the 31-day model, so no recommendations were made to change the Summer run pDBE. Natural salmon passage through Big Bar continued and it was estimated that 562,436 sockeye had passed to date.

August 21 – 27, 2022:

The total accounted run to date was 3,820,000 sockeye salmon, consisting of 244,300 Early Stuart, 584,500 Early Summer-, 2,514,600 Summer- and 476,600 Late-run sockeye. Purse seine catches decreased considerably, especially in Area 12, and the 5-day diversion rate dropped to 16%, which is very unusual this late in the season. Given the unexpected decreased diversion rate, U.S. catches since last Thursday were much larger than predicted. On August 23, catches totaled 696,000 Fraser sockeye, with 322,000 caught by the U.S., 344,000 caught by Canada, and 30,000 caught in the various test fisheries. Following the drop in test fishing catches and the levelling of Mission abundance estimates, at the meeting on Monday, the Panel reduced the Early Summer-run, Summer-run and Late-run run size to 600,000, 3,500,000 and 1,200,000 respectively. The associated 50% marine timing in Area 20 for the different management groups were July 30, August 14 and August 15 respectively. The reductions in run size for Early Summer and Late run removed any available TAC for international sharing for these two groups and eliminated any remaining U.S. TAC. In the U.S., the previously Panel approved extension of the Treaty Tribal fishery in Areas 4B, 5, and 6C was closed prematurely on August 23 instead of August 24.

At the Panel meeting on Friday, troll test fishing estimates indicated that a larger than anticipated number of Late run sockeye were delaying their migration into the Fraser River. The Panel increased the run size for Late run sockeye to 1,600,000 with an associated Area 20 timing of August 16. Total catches had further increased to 909,000 Fraser sockeye, with 317,000 caught by the U.S., 560,000 caught by Canada, and 32,000 caught in the various test fisheries. These catches represented about 24% of the 3.8 million accounted run-to-date. All Panel Area waters remained closed to commercial salmon fishing.

On August 25, the Fraser River water discharge at Hope was $3,344 \text{ m}^3\cdot\text{s}^{-1}$, which, while still 22% greater than average for this date, did not impede salmon migration. The temperature of the Fraser River at Qualark had increased to above average temperatures for this time of year, 20.3°C. DFO's Environmental Watch program projected that discharge would further decrease to $3,087 \text{ m}^3\cdot\text{s}^{-1}$ over the next 10 days while river temperature was predicted to remain high at 19.1°C, which was similar to the recorded maxima, for this period (1990-2020), and exceeded the optimal temperature for salmon migration. Natural salmon passage through Big Bar continued and it was estimated that 1,180,421 sockeye had passed the area to date.

August 28 – September 3, 2022:

The total accounted run to date was 5,014,300 consisting of 244,500 Early Stuart, 604,600 Early Summer-, 3,374,800 Summer- and 790,400 Late run sockeye. Purse seine catches decreased in both Area 12 and 20 and marine test fisheries ended Sept 3 and 4, respectively. The diversion rate had increased to 66% which was still lower than expected for the time of year. In the river, the Whonnock in-river sample from August 31 indicated a substantial increase in the proportion of delaying Late run; 48% compared to the 24% in the sample from August 29-30. There were concerns that the Late run sockeye that had been delaying in the Gulf had started their migration into the Fraser River.

At the meeting on Friday, the Panel adopted an increase to the Summer-run run size to 3,700,000 with an associated Area 20 timing of August 15, which was 5 days later than assumed preseason. For Late run sockeye, the second Gulf Troll survey indicated much lower abundance in the Strait of Georgia compared to the first survey. Despite this lower estimate for the delay component, the resulting Late-run run size estimate equaled 2 million. An alternative run size estimate based on CPUE data for Late run multiplied with an adjusted in-season expansion line based on the Summer run expansion line indicated a total Late-run run size of 1.7 million. While

an increase of the Late-run run size to 1,850,000 was recommended, the Panel declined the recommendation. There were concerns from the Panel that the Late run was not delaying in the Gulf and fish entering the Fraser River were being exposed to well above average water temperatures. The Panel wanted to see the results of the next Gulf troll survey and resulting estimates of the delay component before making any run size changes. Total catches this week had increased to 1,076,000 Fraser sockeye, with 722,000 caught by Canada, 319,000 caught by the U.S., and 35,000 caught in the various test fisheries.

On September 1, the Fraser River water discharge at Hope was $2,956 \text{ m}^3 \cdot \text{s}^{-1}$ which was 19% above average for this date. The temperature of the Fraser River at Qualark remained high at 19.2°C , 2.1°C above average, which also exceeded the optimal temperatures for salmon migration. Given the in-river environmental conditions, observations of poor fish condition and observed discrepancies between expected and observed Summer run abundance at Big Bar, the Panel adopted a proportional Management Adjustment (pMA) for the Summer run of 0.19. Unimpeded natural salmon passage through Big Bar continued and it was estimated that 1,491,857 sockeye had passed the area to date.

September 4 – 10, 2022:

The total accounted run to date was 5,420,000 sockeye salmon, consisting of 244,500 Early Stuart, 605,500 Early Summer-, 3,629,100 Summer- and 940,900 Late-run sockeye. With the closure of the Area 12 and Area 20 test fisheries on September 4, the diversion rate was the annual average to date, 34%.

For delaying Late-run sockeye (Late run excluding Birkenhead/Big Silver), the estimated run size on Tuesday was 1.5 million based on daily CPUE data for this group multiplied with an adjusted in-season expansion line based on the Summer-run expansion line. This estimate implied close to 0.8 million sockeye delaying in the Strait of Georgia, which was much lower than the 2.4 million implied by the third Gulf Troll survey. The resulting run size estimates for the entire Late run therefore ranged from 1.7 million based on the CPUE data to 3.3 million based on the Gulf Troll estimate. At the meeting on Tuesday, PSC staff did not provide a recommendation for Late run given the significant uncertainty associated with its run size. The Panel adopted an increased run size of 1,850,000 based on the recommendation from staff from the previous week, as proposed by Canada. The timing remained August 16. Following the increased Late-run run size, Canada proposed an Area B purse seine ITQ fishery in the Strait of Georgia (Portions of Subareas 29-3, 4, 6 and 10, seaward of the 45 meter depth contour) and an Area H troll ITQ fishery in Subareas 18-1 and 29-1 to 6 of the Strait of Georgia. Total catches on Friday had increased to 1,165,000 Fraser sockeye, with 809,000 caught by Canada, 319,000 caught by the U.S., and 37,000 caught in the various test fisheries.

On September 8, the Fraser River water discharge at Hope was $2,567 \text{ m}^3 \cdot \text{s}^{-1}$, which was 11% greater than average for this date. The temperature of the Fraser River at Qualark had decreased to 17.7°C , which was still 1.5°C above average for this time of year. Natural salmon passage through Big Bar continued and it was estimated that 2,261,485 sockeye had passed to date.

September 11- 17, 2022

The total accounted run to date was 6,028,400 sockeye salmon, consisting of 244,500 Early Stuart, 606,300 Early Summer-, 3,787,600 Summer- and 1,390,000 Late-run sockeye. Most of the Fraser sockeye run had been observed in catch plus escapement with the exception of the delaying Late run component and any co-migrating Summer run sockeye. At Tuesday's meeting, the Panel adopted an increased run size for Summer run of 3,750,000 based on the increase in abundance observed at Mission. The relatively low daily abundance estimates at Mission however indicated that the delaying Late run component had not yet migrated up the river. This was confirmed by the preliminary Gulf Troll estimate using data from the two quadrants surveyed thus far. Model results based on the annual CPUE of Late run multiplied with the annual Late run expansion line, derived from the correlation between annual Summer and Late run expansion lines, indicated a Late-run run size of 2 million. As a result, at the Tuesday meeting the Panel also adopted a Late-run run size of 2,000,000 with an associated Area 20 date of August 17. In addition, the Panel also

adopted an Early Summer run size of 607,000 based on current catch plus escapement. On Friday, the Panel adopted an increased Summer run of 3,800,000. This increase in the run size for Summer run in turn impacted the estimate for Late run based on the annual CPUE data and the Panel also adopted an increased run size for Late run of 2,050,000. Total catches this week had increased to 1,387,000 Fraser sockeye, with 1,029,000 caught by Canada, 319,000 caught by the U.S., and 39,000 caught in the various test fisheries.

On September 15, the Fraser River water discharge at Hope was $1,949 \text{ m}^3 \cdot \text{s}^{-1}$ which was slightly below average, and the temperature of the Fraser River at Qualark was 16.8°C , which was still 1.6°C above average for this time of year. Natural salmon passage through Big Bar continued and it was estimated that 2,651,073 sockeye had passed to date.

September 18- 24, 2022

The total accounted run to date was 6,313,600 sockeye salmon, consisting of 244,500 Early Stuart, 606,300 Early Summer-, 3,789,300 Summer- and 1,673,500 Late-run sockeye which included 1,098,100 in catch downstream of Mission.

There were no changes in run sizes proposed at the meeting on Tuesday.

On September 19, the Fraser River water temperature at Qualark was 15.0°C which was slightly below average, and the discharge of the Fraser River at Hope was $1,841 \text{ m}^3 \cdot \text{s}^{-1}$, about 6% below the historical average.

At the final post season meeting on September 28 the Panel adopted updated run sizes for the Summer and Late run of 3,805,000 and 2,150,000, respectively, resulting in a total run size estimate of 6,806,000 (Table 1). There were no changes to the timing estimates for these two management groups.

On October 8, Panel control of the last U.S. Panel Area was relinquished, in accordance with the pre-season regulations. The TAC calculation was based on the last in-season run size estimate adopted by the Panel (September 28) as per revised Treaty language for Chapter 4, Annex IV. The achievement of in-season catch objectives was assessed through a comparison with post-season catch estimates in the Achievement of Objectives section of this report.

Table 1. Pre-season and in-season updates of run size, spawning escapement targets and other TAC-related values for Fraser River salmon in 2022. 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*										
	Management	Total	Spawning		Management	Test	Aboriginal		Total	Total	Available	Downstream	Mission
Date	Group	Abundance	Escapement	pMA	Adjust.	Fishing	Fishery		Deductions	Allowable	Harvest	Catch	Escape.
			Target				Exemption				**	to date	to date
June 22	Pre-season***	Early Stuart	105,000	105,000	1.00	105,000	1,000	0	105,000	0	0	0	0
		Early Summer	1,579,000	789,600	0.59	465,900	13,100	82,059	1,350,659	228,341	323,500	0	0
		Summer	4,402,600	2,201,300	0.04	88,100	34,200	169,691	2,493,291	1,909,309	2,113,200	0	0
		Late	3,688,000	1,844,000	0.22	405,700	26,700	148,250	2,424,650	1,263,350	1,438,300	0	0
		Sockeye	9,774,600	4,939,900		1,064,700	75,000	400,000	6,373,600	3,401,000	3,875,000	0	0
July 12	In-season	Early Stuart	105,000	105,000	1.00	105,000	1,000	0	105,000	0	0	352	109,406
		Early Summer	1,579,000	789,600	0.59	465,900	13,100	82,059	1,350,659	228,341	323,500	33	4,040
		Summer	4,403,000	2,201,300	0.04	88,100	34,200	169,691	2,493,291	1,909,709	2,113,600	0	0
		Late	3,688,000	1,844,000	0.22	405,700	26,700	148,250	2,424,650	1,263,350	1,438,300	0	0
		Sockeye	9,775,000	4,939,900		1,064,700	75,000	400,000	6,373,600	3,401,400	3,875,400	0	113,446
July 15	In-season	Early Stuart	105,000	105,000	1.00	105,000	1,000	0	105,000	0	0	700	169,600
		Early Summer	1,579,000	789,600	0.59	465,900	13,100	82,059	1,350,659	228,341	323,500	300	8,800
		Summer	4,403,000	2,201,300	0.04	88,100	34,200	169,691	2,493,291	1,909,709	2,113,600	0	0
		Late	3,688,000	1,844,000	0.22	405,700	26,700	148,250	2,424,650	1,263,350	1,438,300	0	0
		Sockeye	9,775,000	4,939,900		1,064,700	75,000	400,000	6,373,600	3,401,400	3,875,400	1,000	178,400
July 19	In-season	Early Stuart	230,000	184,000	13.29	2,445,400	1,000	0	230,000	0	0	600	202,200
		Early Summer	1,579,000	789,600	0.59	465,900	13,100	82,059	1,350,659	228,341	323,500	700	23,700
		Summer	4,403,000	2,201,300	0.04	88,100	34,200	169,691	2,493,291	1,909,709	2,113,600	0	0
		Late	3,688,000	1,844,000	0.22	405,700	26,700	148,250	2,424,650	1,263,350	1,438,300	0	0
		Sockeye	9,900,000	5,018,900		3,405,100	75,000	400,000	6,498,600	3,401,400	3,875,400	1,300	225,900
July 22	In-season	Early Stuart	230,000	184,000	13.29	2,445,400	1,000	0	230,000	0	0	700	213,500
		Early Summer	1,579,000	789,600	0.59	465,900	13,100	82,059	1,350,659	228,341	323,500	900	53,000
		Summer	4,403,000	2,201,300	0.04	88,100	34,200	169,691	2,493,291	1,909,709	2,113,600	200	200
		Late	3,688,000	1,844,000	0.22	405,700	26,700	148,250	2,424,650	1,263,350	1,438,300	0	0
		Sockeye	9,900,000	5,018,900		3,405,100	75,000	400,000	6,498,600	3,401,400	3,875,400	1,800	266,700
July 26	In-season	Early Stuart	230,000	184,000	13.29	2,445,400	1,000	0	230,000	0	0	800	226,900
		Early Summer	1,579,000	789,600	0.59	465,900	13,100	82,059	1,350,659	228,341	323,500	1,700	121,000
		Summer	4,403,000	2,201,300	0.04	88,100	34,200	169,691	2,493,291	1,909,709	2,113,600	600	11,000
		Late	3,688,000	1,844,000	0.22	405,700	26,700	148,250	2,424,650	1,263,350	1,438,300	100	600
		Sockeye	9,900,000	5,018,900		3,405,100	75,000	400,000	6,498,600	3,401,400	3,875,400	3,200	359,500
July 29	In-season	Early Stuart	230,000	184,000	13.29	2,445,400	1,000	0	230,000	0	0	800	231,300
		Early Summer	1,579,000	789,600	0.59	465,900	13,100	82,059	1,350,659	228,341	323,500	2,400	166,600
		Summer	4,403,000	2,201,300	0.04	88,100	34,200	169,691	2,493,291	1,909,709	2,113,600	1,700	37,200
		Late	3,688,000	1,844,000	0.22	405,700	26,700	148,250	2,424,650	1,263,350	1,438,300	300	2,500
		Sockeye	9,900,000	5,018,900		3,405,100	75,000	400,000	6,498,600	3,401,400	3,875,400	5,200	437,600
August 2	In-season	Early Stuart	230,000	184,000	13.29	2,445,400	1,000	0	230,000	0	0	900	240,900
		Early Summer	1,579,000	789,600	0.59	465,900	13,100	82,059	1,350,659	228,341	323,500	3,400	229,100
		Summer	4,403,000	2,201,300	0.04	88,100	34,200	169,691	2,493,291	1,909,709	2,113,600	3,600	101,700
		Late	3,688,000	1,844,000	0.22	405,700	26,700	148,250	2,424,650	1,263,350	1,438,300	800	7,800
		Sockeye	9,900,000	5,018,900		3,405,100	75,000	400,000	6,498,600	3,401,400	3,875,400	8,700	579,500
August 5	In-season	Early Stuart	230,000	184,000	13.29	2,445,400	1,050	0	230,000	0	0	1,000	240,000
		Early Summer	1,579,000	789,600	0.59	465,900	14,890	82,059	1,352,449	226,551	323,500	6,400	271,500
		Summer	4,403,000	2,201,300	0.04	88,100	52,890	169,691	2,511,981	1,891,019	2,113,600	11,300	210,400
		Late	3,688,000	1,844,000	0.22	405,700	39,170	148,250	2,437,120	1,250,880	1,438,300	2,900	15,900
		Sockeye	9,900,000	5,018,900		3,405,100	108,000	400,000	6,531,550	3,368,450	3,875,400	21,600	737,800
August 9	In-season	Early Stuart	241,000	192,800	13.29	2,562,300	1,050	0	241,000	0	0	1,000	240,000
		Early Summer	764,000	382,000	0.59	225,400	14,890	82,059	704,349	59,651	156,600	8,900	321,000
		Summer	4,403,000	2,201,300	0.04	88,100	52,890	169,691	2,511,981	1,891,019	2,113,600	16,600	367,700
		Late	3,688,000	1,844,000	0.22	405,700	39,170	148,250	2,437,120	1,250,880	1,438,300	5,000	35,900
		Sockeye	9,096,000	4,620,100		3,281,500	108,000	400,000	5,894,450	3,201,550	3,708,500	31,500	964,600
August 12	In-season	Early Stuart	244,000	195,200	13.29	2,594,200	1,050	0	244,000	0	0	900	243,000
		Early Summer	792,000	396,000	0.59	233,600	14,890	82,059	726,549	65,451	162,400	15,200	448,200
		Summer	4,403,000	2,201,300	0.04	88,100	52,890	169,691	2,511,981	1,891,019	2,113,600	42,800	785,800
		Late	3,688,000	1,844,000	0.22	405,700	39,170	148,250	2,437,120	1,250,880	1,438,300	13,500	46,500
		Sockeye	9,127,000	4,636,500		3,321,600	108,000	400,000	5,919,650	3,207,350	3,714,300	72,400	1,523,500
August 16	In-season	Early Stuart	244,000	195,200	13.29	2,594,200	1,050	0	244,000	0	0	1,000	243,000
		Early Summer	614,000	375,500	0.59	221,500	14,890	82,059	614,000	0	17,000	30,300	470,600
		Summer	4,403,000	2,201,300	0.04	88,100	52,890	169,691	2,511,981	1,891,019	2,113,600	159,700	1,028,700
		Late	3,688,000	1,844,000	0.22	405,700	39,170	148,250	2,437,120	1,250,880	1,438,300	54,100	78,100
		Sockeye	8,949,000	4,616,000		3,309,500	108,000	400,000	5,807,101	3,141,899	3,568,900	245,100	1,820,700

Table 1, continued on next page

Table 1, continued

Date	Management Group	Total Abundance	TAC*						Total Allowable Catch	Available Harvest **	Downstream Catch to date	Mission Passage to date
			Spawning Escapement Target	Management pMA	Adjust.	Test Fishing	Aboriginal Fishery Exemption***	Total Deductions				
August 18	In-season	Early Stuart	244,000	195,200	13.29	2,594,200	1,050	0	244,000	0	0	243,300
		Early Summer	627,000	375,500	0.59	221,500	9,390	55,000	627,000	0	30,000	494,500
		Summer	4,403,000	2,201,300	0.04	88,100	49,890	184,133	2,523,423	1,879,577	2,113,600	1,259,600
		Late	2,000,000	1,104,800	0.22	243,100	37,170	160,867	1,545,937	454,063	652,100	98,700
		Sockeye	7,274,000	3,876,800		3,146,900	97,500	400,000	4,940,360	2,333,640	2,795,700	2,096,100
August 22	In-season	Early Stuart	244,000	195,200	13.29	2,594,200	1,050	0	244,000	0	0	243,300
		Early Summer	600,000	375,500	0.59	221,500	9,390	55,000	600,000	0	3,000	531,900
		Summer	3,500,000	1,750,000	0.04	70,000	49,890	184,133	2,054,023	1,445,977	1,680,000	1,645,900
		Late	1,200,000	1,104,800	0.22	243,100	37,170	160,867	1,200,000	0	0	238,300
		Sockeye	5,544,000	3,425,500		3,128,800	97,500	400,000	4,098,023	1,445,977	1,683,000	2,659,400
August 23	In-season	Early Stuart	244,000	195,200	13.29	2,594,200	1,079	1,537	244,000	0	0	243,300
		Early Summer	600,000	375,500	0.59	221,500	7,000	70,000	600,000	0	3,000	536,800
		Summer	3,500,000	1,750,000	0.04	70,000	22,000	175,307	2,017,307	1,482,693	1,680,000	1,768,400
		Late	1,200,000	1,104,800	0.22	243,100	12,000	153,156	1,200,000	0	0	231,700
		Sockeye	5,544,000	3,425,500		3,128,800	42,079	400,000	4,061,307	1,482,693	1,683,000	2,780,200
August 26	In-season	Early Stuart	244,000	195,200	13.29	2,594,200	1,079	1,697	244,000	0	0	243,300
		Early Summer	600,000	375,500	0.59	221,500	7,000	70,000	600,000	0	3,000	545,200
		Summer	3,500,000	1,750,000	0.04	70,000	22,000	175,221	2,017,221	1,482,779	1,680,000	2,063,200
		Late	1,600,000	1,104,800	0.22	243,100	12,000	153,082	1,512,982	87,018	252,100	257,300
		Sockeye	5,944,000	3,425,500		3,128,800	42,079	0	4,374,203	1,569,797	1,935,100	3,109,000
August 30	In-season	Early Stuart	244,000	195,200	13.29	2,594,200	1,079	1,697	244,000	0	0	243,300
		Early Summer	600,000	375,500	0.59	221,500	7,000	70,000	600,000	0	3,000	564,500
		Summer	3,500,000	1,750,000	0.04	70,000	22,000	175,221	2,017,221	1,482,779	1,680,000	2,599,800
		Late	1,600,000	1,104,800	0.22	243,100	12,000	153,082	1,512,982	87,018	252,100	552,100
		Sockeye	5,944,000	3,425,500		3,128,800	42,079	0	4,374,203	1,569,797	1,935,100	3,959,700
September 2	In-season	Early Stuart	244,000	195,200	13.29	2,594,200	1,079	1,697	244,000	0	0	243,300
		Early Summer	600,000	375,500	0.59	221,500	7,000	70,000	600,000	0	3,000	563,900
		Summer	3,700,000	1,850,000	0.19	351,500	22,000	175,221	2,398,721	1,301,279	1,498,500	2,854,400
		Late	1,600,000	1,104,800	0.22	243,100	12,000	153,082	1,512,982	87,018	252,100	542,500
		Sockeye	6,144,000	3,525,500		3,410,300	42,079	400,000	4,755,703	1,388,297	1,753,600	4,204,100
September 6	In-season	Early Stuart	244,000	195,200	13.29	2,594,200	1,079	1,697	244,000	0	0	243,300
		Early Summer	600,000	375,500	0.59	221,500	6,600	70,000	600,000	0	3,000	564,100
		Summer	3,700,000	1,850,000	0.19	351,500	22,900	175,221	2,399,621	1,300,379	1,498,500	3,012,400
		Late	1,850,000	1,104,800	0.22	243,100	12,000	153,082	1,512,982	337,018	502,100	652,500
		Sockeye	6,394,000	3,525,500		3,410,300	42,579	400,000	4,756,603	1,637,397	2,003,600	4,472,300
September 9	In-season	Early Stuart	244,000	195,200	13.29	2,594,200	1,079	1,697	244,000	0	0	243,300
		Early Summer	600,000	375,500	0.59	221,500	6,600	70,000	600,000	0	3,000	564,300
		Summer	3,700,000	1,850,000	0.19	351,500	22,900	175,221	2,399,621	1,300,379	1,498,500	3,092,500
		Late	1,850,000	1,104,800	0.22	243,100	12,000	153,082	1,512,982	337,018	502,100	677,400
		Sockeye	6,394,000	3,525,500		3,410,300	42,579	400,000	4,756,603	1,637,397	2,003,600	4,577,500
September 13	In-season	Early Stuart	244,000	195,200	13.29	2,594,200	1,079	1,697	244,000	0	0	243,300
		Early Summer	607,000	375,500	0.59	221,500	6,600	70,000	607,000	0	10,000	565,600
		Summer	3,750,000	1,875,000	0.19	356,300	22,900	175,221	2,429,421	1,320,579	1,518,700	3,208,700
		Late	2,000,000	1,104,800	0.22	243,100	12,000	153,082	1,512,982	487,018	652,100	733,200
		Sockeye	6,601,000	3,550,500		3,415,100	42,579	400,000	4,793,403	1,807,597	2,180,800	4,750,800
September 16	In-season	Early Stuart	244,000	195,200	13.29	2,594,200	1,079	1,697	244,000	0	0	243,300
		Early Summer	607,000	375,500	0.59	221,500	6,600	70,000	607,000	0	10,000	565,200
		Summer	3,800,000	1,900,000	0.19	361,000	22,900	175,221	2,459,121	1,340,879	1,539,000	3,241,000
		Late	2,050,000	1,104,800	0.22	243,100	12,000	153,082	1,512,982	537,018	702,100	914,500
		Sockeye	6,701,000	3,575,500		3,419,800	42,579	400,000	4,823,103	1,877,897	2,251,100	4,964,000
September 20	End-of-season	Early Stuart	244,000	195,200	13.29	2,594,200	1,079	1,697	244,000	0	0	243,300
		Early Summer	607,000	375,500	0.59	221,500	6,600	70,000	607,000	0	10,000	565,200
		Summer	3,800,000	1,900,000	0.19	361,000	22,900	175,221	2,459,121	1,340,879	1,539,000	3,247,300
		Late	2,050,000	1,104,800	0.22	243,100	12,000	153,082	1,512,982	537,018	702,100	1,159,700
		Sockeye	6,701,000	3,575,500		3,419,800	42,579	400,000	4,823,103	1,877,897	2,251,100	5,215,500

Table 1, continued on next page

Table 1, continued

			TAC*							Available Harvest **	Downstream Catch to date	Mission Passage to date	
			Spawning Escapement	Management		Test	Aboriginal Fishery	Total	Total Allowable				
Date	Management Group	Total Abundance	Target	pMA	Adjust.	Fishing	Exemption	Deductions	Catch				
September 28	Post-season	Early Stuart	244,000	195,200	13.29	2,594,200	1,079	1,697	244,000	0	0	1,200	243,300
		Early Summer	607,000	375,500	0.59	221,500	6,600	70,000	607,000	0	10,000	41,100	565,200
		Summer	3,805,000	1,902,500	0.19	361,500	22,900	175,221	2,462,121	1,342,879	1,541,000	542,400	3,266,500
		Late	2,150,000	1,104,800	0.22	243,100	12,000	153,082	1,512,982	637,018	802,100	522,100	1,570,800
		Sockeye	6,806,000	3,578,000		3,420,300	42,579	400,000	4,826,103	1,979,897	2,353,100	1,106,800	5,645,800

* 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. 28).

** 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 (i.e., 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.

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, hydroacoustics and observers. The locations and schedule for these Staff and DFO programs are listed in Table 2. 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 3 shows the sockeye stock resolution that was reported in 2022.

Table 2. Panel-approved stock monitoring operations (test fishery, hydroacoustic and observer) conducted during the 2022 fishing season.

Area	Location	Gear	Dates	Operated by
Canadian Panel Areas				
20	Juan de Fuca Str.	Gillnet	July 10 - August 16	PSC
20	Juan de Fuca Str.	Purse Seine	July 25 - September 4	PSC
29-1 to 6	Str. of Georgia	Troll	August 23 - September 19	PSC
29-14	Fraser R. (Cottonwood)	Gillnet	July 12 - September 26	PSC
29-16	Fraser R. (Whonnock)	Gillnet	June 22 - October 9	PSC
29-16	Fraser R. (Mission)	Hydroacoustic	July 1 - October 2	PSC
Canadian non-Panel Areas				
12	Queen Charlotte Str. (Round Is.)	Gillnet	July 12 - August 14	DFO
12	Johnstone Str. (Blinkhorn)	Purse Seine	July 24 - September 4	DFO
13	Lower Johnstone Str.	Purse Seine	July 26 - August 20	DFO
	Fraser R. (Hells Gate)	Observer	July 5 - September 29	PSC
	Fraser R. (Qualark)	Gillnet	July 15 - October 6	DFO
	Fraser R. (Qualark)	Hydroacoustic	July 15 - October 7	DFO
United States Panel Areas				
5	Juan de Fuca Str.	Gillnet	July 26 - July 29	PSC
7	San Juan Islands	Reefnet	July 27 - August 8	PSC

Table 3. Individual stocks included in the Fraser River sockeye stock groups used in 2022.

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 South Thompson	Scotch, Seymour, early Eagle, Cayenne, Upper Adams
North Barriere	Upper Barriere
Summer	
Raft/N.Thompson	Raft, North Thompson main stem
Chilko	Chilko River, south end Chilko Lake, north end Chilko Lake
Horsefly/McKinley	Horsefly, McKinley
Mitchell/Lake Tributaries	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	

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 (temperature and discharge) 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.

A. Abundance

The final in-season run size estimate adopted by the Panel was 6,806,000 Fraser River sockeye salmon (Table 1). While this abundance allowed for fishing opportunities for both countries, it was much less than anticipated pre-season. The post-season sockeye abundance estimate (6,936,000 fish, Tables 6 and 7) based on spawning ground enumerations, accounted catches and differences between estimates is slightly larger than the end-of-season estimate, 2%, but lower than the pre-season median forecast (9,775,000).

B. Migration Timing and Diversion Rate

Figure 3 shows the forecasted and observed daily abundances, and Area 20 50% migration dates for each sockeye management group and for the total Fraser River sockeye run. The end-of-season estimate of marine migration timing in 2022 was similar to the pre-season expectation for

Early Stuart (2-days later) but earlier than pre-season expectations for Early Summer-run (7-days earlier), and later than pre-season expectations for Summer-run (5 days later) management groups. The end-of-season timing estimate was also similar to the pre-season expectation for the Late-run (2-days earlier) management group. The overall sockeye run was 1-day later than expected pre-season.

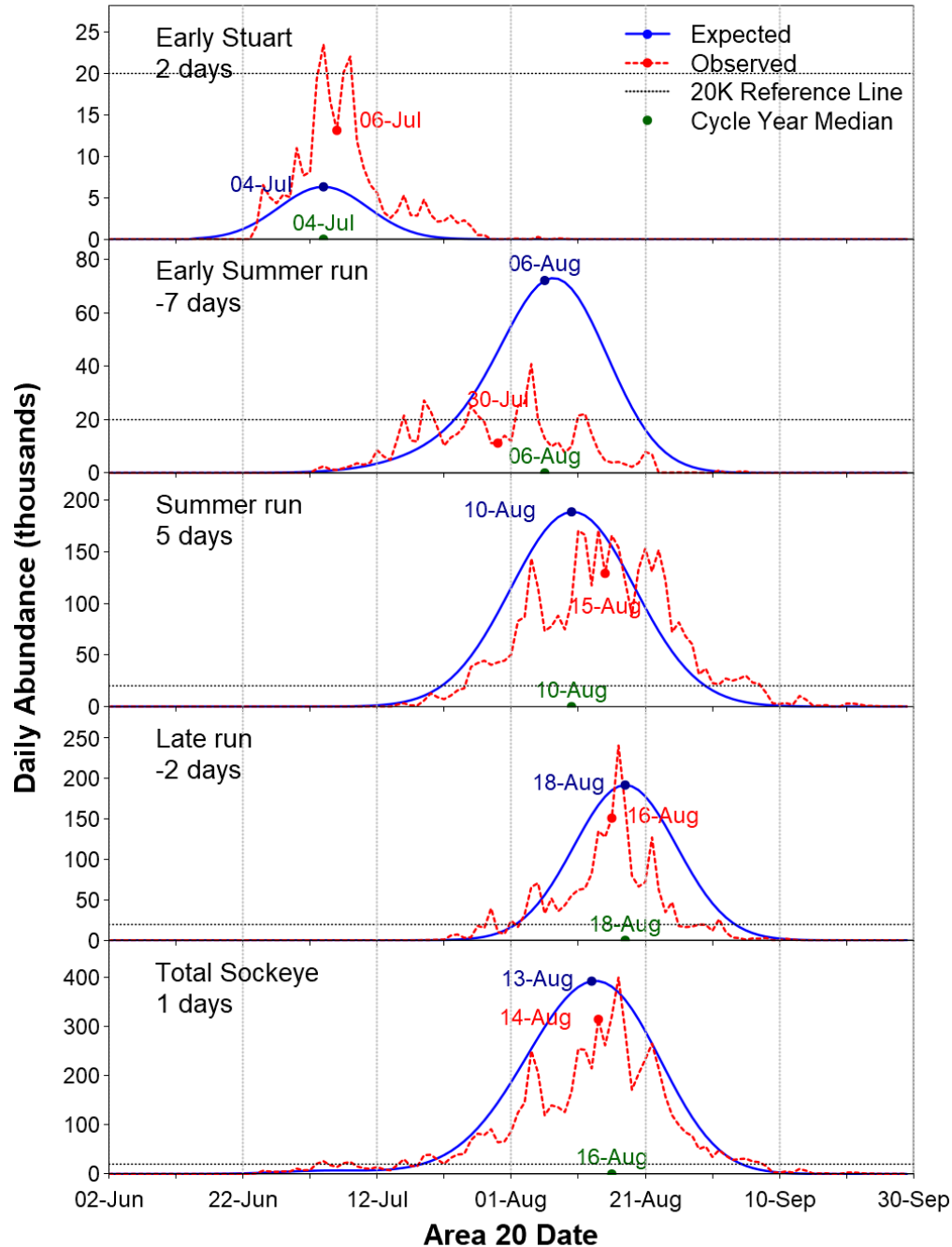


Figure 3. Pre-season expectations and post-season reconstructions of daily Fraser River sockeye salmon abundance by management group in 2022 (Area 20 date), including the observed 50% dates and number of days difference with pre-season expectations.

The diversion rate in 2022 was lower than forecast as the observed annual diversion through Johnstone Strait was 34%, compared to the initial forecast of 48% used for pre-season planning (Figure 4).

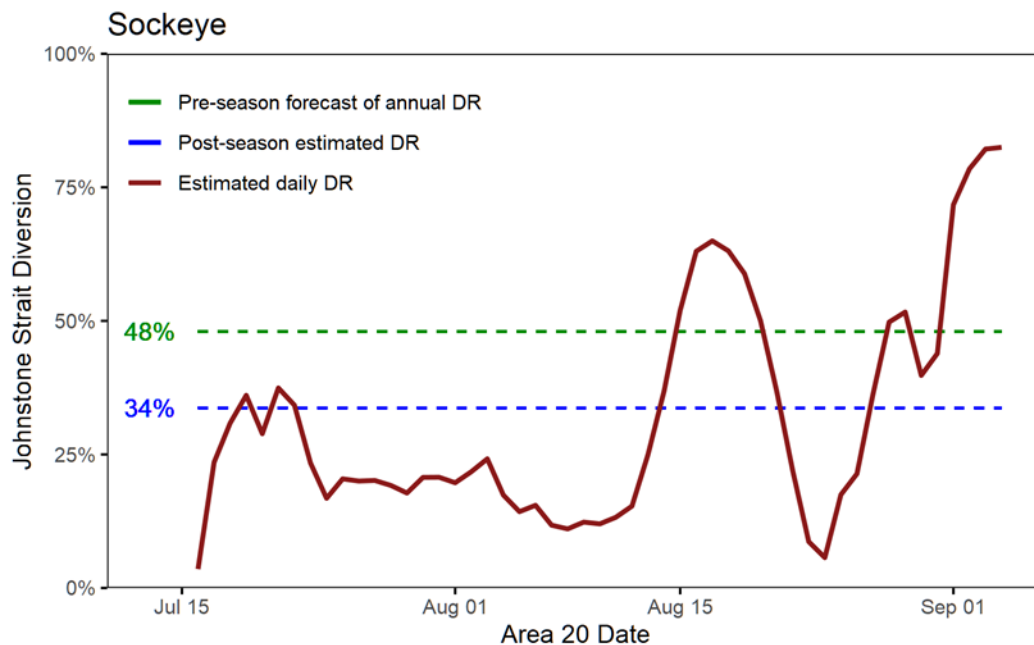


Figure 4. Pre-season forecast of annual Johnstone Strait diversion rate (DR) for Fraser sockeye salmon, compared to post-season estimates of daily and annual rates for 2022.

C. Big Bar Landslide

Since the occurrence of the Big Bar rockslide in 2019 (Figure 5), considerable work has been undertaken to improve salmon migration conditions at the slide, including through the construction of a nature-life fishway. After the 2021 season, it was decided that a structured decision-making process would take place to determine a long-term solution to restore fish passage at the Big Bar slide. As the different phases of the structured decision-making process moved forward, the plan for the 2022 salmon migration at the Big Bar slide was to provide continued fish “trap and transport”, enhancement and monitoring operations.

In 2022 an array of sonar equipment and radio tag receivers were installed at Big Bar and along the Fraser (Figure 6). Three fishwheel sites were operational to enable the collection of brood stock and for tagging operations. In 2022, 63% of the total Fraser River sockeye run needed to pass the site: 100% of the Early Stuart, 46% of the Early Summers run, and 97% of the Summer run. To provide in-season feedback to managers about natural passage success of all salmon, hydroacoustic fish monitoring stations were set up downstream and upstream of the slide and fish were radio tagged to track the quantity of fish traveling through the slide site. Radio tag receivers were set up along the Fraser River and in tributaries which also informed the Stock Monitoring group on fish behavior associated with barriers and salmon condition.

As a result of the delayed snowmelt, high discharge levels in July did impact the Early Stuart and early arriving Early Summer-run sockeye migration. The high discharge slowed down the upstream migration and at the start of the season it took three times longer than normal to migrate from Matsqui to Qualark. A large portion of the Early Stuart migration failed to migrate through the lower canyon and never made it to Big Bar. When sockeye did begin to arrive at Big Bar,

discharge levels were already below the minimum unimpeded discharge level of 4,300 m³/s, and sockeye successfully migrated past the slide.

Of the sockeye stocks that spawn above Big Bar, the following proportions made it to the spawning grounds: 10% of the Early Stuart run, all of the Early Summer-run and 60% of the Summer-run. Above average discharge levels and water temperature in 2022 had a larger impact on successful migration than the Big Bar rockslide.

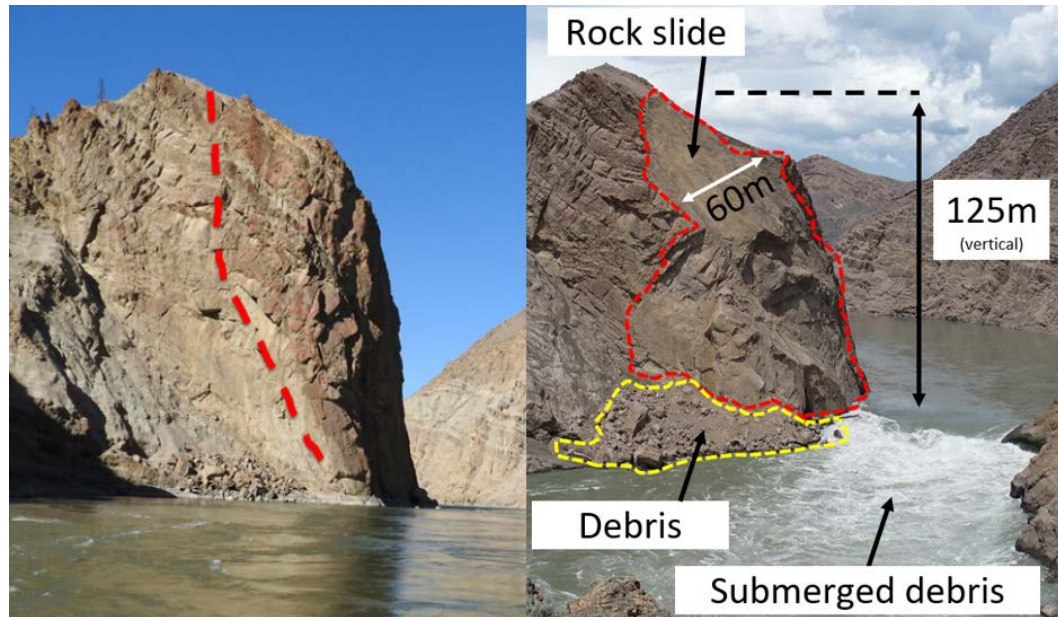


Figure 5. Big Bar Site before (A) and after (B) the slide. (A) The red line depicts what part of the cliff fell into the Fraser River. (B) Rock and debris 125 m in height and 60 m in width fell onto the banks and into the Fraser River.

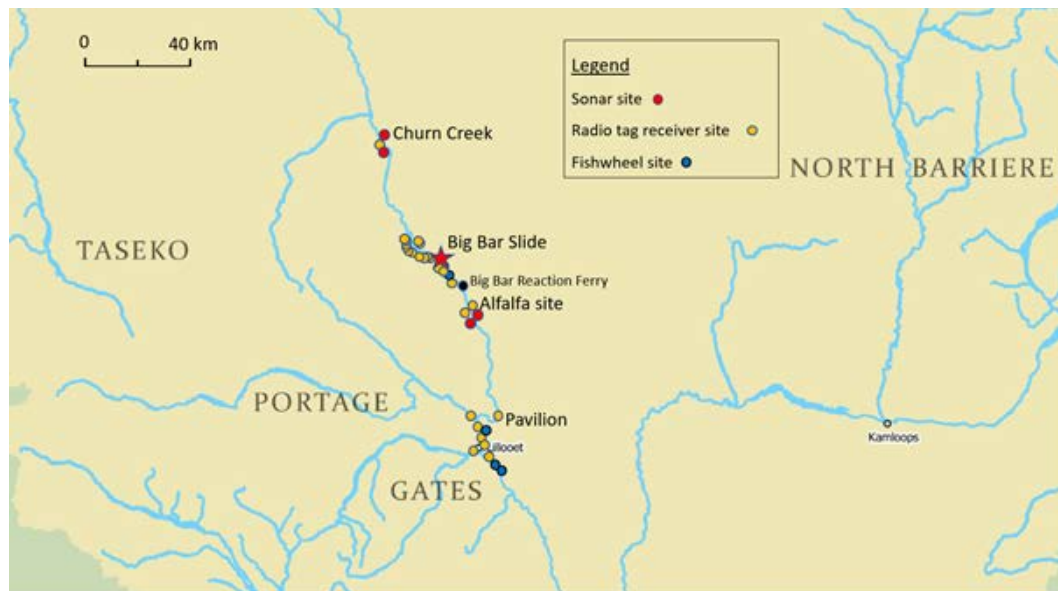


Figure 6. Map of sonar, salmon capture and radio tag receiver locations on the Fraser River near the Big Bar landslide in 2022.

D. Management Adjustments and DBEs

Management Adjustments (MAs) are based on statistical models¹⁴ 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).¹⁵

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.¹⁶ 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.^{13,14} In contrast, post-season values are calculated independently of any environmental data using post-season estimates of potential spawning and spawning ground escapements.

In 2022, Fraser River peak freshet was in late June and discharge levels reached a peak of over 10,300 m³/s at Hope. Until July 19, discharge levels remained over 8000 m³/s at Hope, which is the discharge threshold above which Early Stuart will experience considerable migration challenges¹⁷. Both Early Stuart and the early timed Early Summer-run migration were impacted by the high discharge. Discharge levels remained near plus one standard deviation through August and did not drop to below average until September 12 (Figure 7). Air temperatures in B.C. were above average and although high Fraser River discharge levels mediated the river temperature somewhat, Fraser River temperature at Qualark was above average through most of August and September. Temperature exceeded the historical maxima for several days in late August and early September and again in late September and early October (Figure 7).

A summary of the pre-season and in-season MA models used during 2022 are provided in the “Management Adjustment and DBE” section in Table F3. Pre-season, the adopted pMAs were based on the best performing forecast method identified in the retrospective analysis (Appendix F; Table F4). In-season, the Panel was presented with pDBE estimates for each management group from the best performing method (Table F3) identified in the retrospective analysis (for further details see Management Adjustment and DBE section in Appendix F). In-season, pMAs of 13.29 and 0.19 (from the Supplemental Approach) were adopted by the Panel for Early Stuart and Summer run, respectively. No changes were made to Early Summer and Late run pMAs (Table 4).

¹⁴ 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

¹⁵ 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

¹⁶ 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

¹⁷ MacDonald, J.S., Foremean, M.G.G., Farrel, T., Williams, I.V., Grout, J., Cass, A., Woodey, J.C., Enzenhofer, H., Clarke, W.C., Houtman, R., Donaldson, E.M., and Barnes, D. 2000. The influence of extreme water temperatures on migrating Fraser River sockeye salmon (*Oncorhynchus nerka*) during the 1998 spawning season. Canadian Technical Report of Fisheries and Aquatic Sciences: 2326.

Table 4. 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 Fisheries and Oceans Canada (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	-50%	1.00	-37%	0.59	-4%	0.04	-18%	0.22
In-season adopted	-93%	13.29	-37%	0.59	-16%	0.19	-18%	0.22
Observed ¹	-90%	8.60	5%	-0.04	-33%	0.50	-38%	0.61

¹ Derived from Near Final escapement estimates.

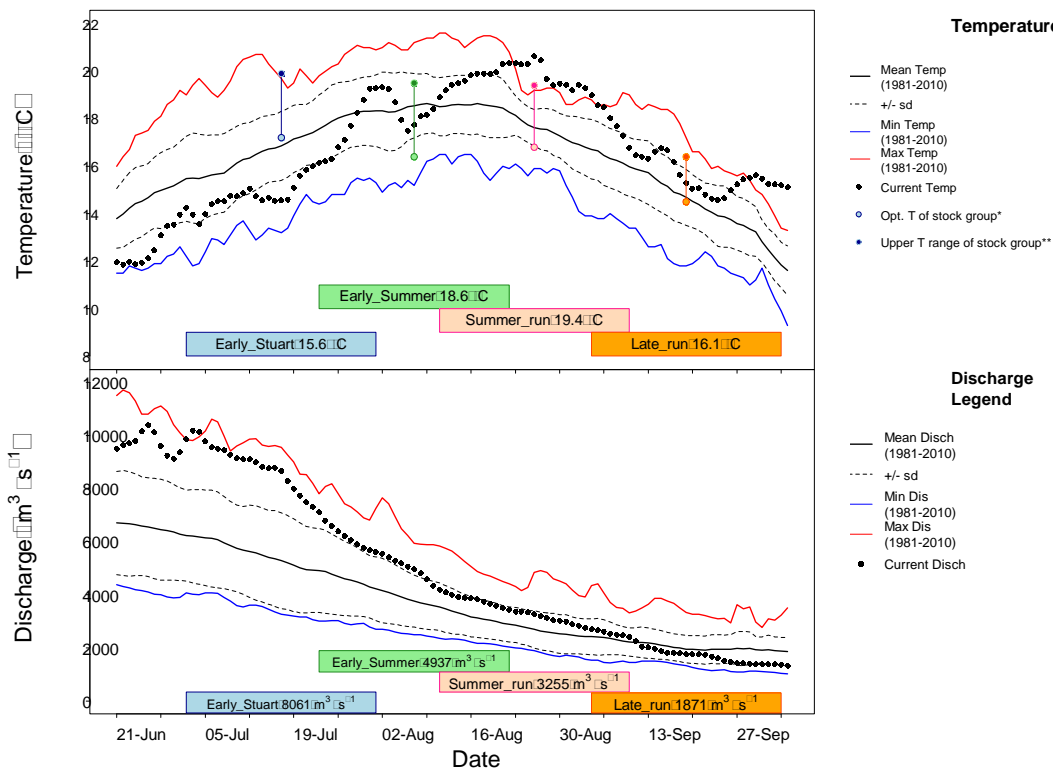


Figure 7. Fraser River temperature and discharge measured near Hope in 2022. Also shown are run timing bars that represent a 31-day spread of the run centred around the Hells Gate date and the mean temperature and discharge for the 31-day spread.

The observed DBE for Early Stuart (-90%) was more negative than that predicted pre-season (-50%) and very close to the in-season adopted DBE of -93% (Table 4). For the Early Summer run, the spawning ground estimates exceeded in-season abundance predictions and the observed DBE was 5% which compared to a predicted pre-season and in-season DBE of -37%. Due to in-season evidence of migration issues, the Panel adopted a more negative DBE (-16%) for Summer run than that predicted pre-season (-4%). However, the observed DBE (-33%) was even more negative than predicted in-season. The observed DBE for Late run (-38%) was higher than

predicted pre-season and in-season (-18%). Spawning ground estimates exceeded the spawning escapement target (SET) for the Early Summer run and the Summer run; however, the SET was not achieved for the Early Stuart and the Late run (Table 11).

E. Mission Passage

The upstream passage estimate of Fraser River sockeye at Mission was 5,648,100, consisting of 243,200 Early Stuart, 566,300 Early Summer-run (including Pitt), 3,253,500 Summer-run, and 1,585,000 Late-run sockeye (Table 5). Sockeye passage estimates were derived using the hydroacoustics monitoring facility at Mission from July 1 to October 2. Before the commencement (June 30) and after the termination (October 3) of the hydroacoustics program, daily sockeye passages were estimated by expansion of CPUE (catch per unit effort) data from the Whonnock gillnet test fishery.

Salmon passage was estimated by the Mission hydroacoustics program using a sampling method similar to that implemented in recent years by combining observations from a vessel-based mobile split-beam, a shore-based split-beam on the left bank, and a shore-based Adaptive Resolution Imaging Sonar (ARIS) on both the right and left banks. As an extension of the 2021 Southern Endowment Fund (SEF) project, in 2022 an ARIS operated on the vessel in the offshore region in addition to the split-beam sonar. Detailed descriptions of the hydroacoustics estimation methodology for 2022 are provided in Appendix F.

Table 5. Fraser River sockeye salmon passage at Mission in 2022.

Management Group Stock Group	Mission Escapement	
	fish	%
Early Stuart	243,200	4%
Early Summer	566,300	10%
Chilliwack	7,400	0%
Early Miscellaneous	278,100	5%
Early South Thompson	244,200	4%
North Barriere/Taseko	10,400	0%
Pitt ¹	26,200	0%
Summer	3,253,500	58%
Raft/N.Thompson	63,400	1%
Chilko	1,281,500	23%
Quesnel	1,555,300	28%
Late Stuart/Stellako	335,500	6%
Harrison	17,800	0%
Late	1,585,000	28%
Birkenhead	177,800	3%
Late Shuswap/Portage	1,084,700	19%
Weaver/Cultus	322,500	6%
Total Sockeye	5,648,100	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 2022 was 7,009,000 fish with an exploitation rate of 23% (Figure 9), which is 29% smaller than the median forecast of Fraser sockeye. The 2022 return was the smallest run size on this cycle since 1970 (Figure 8).

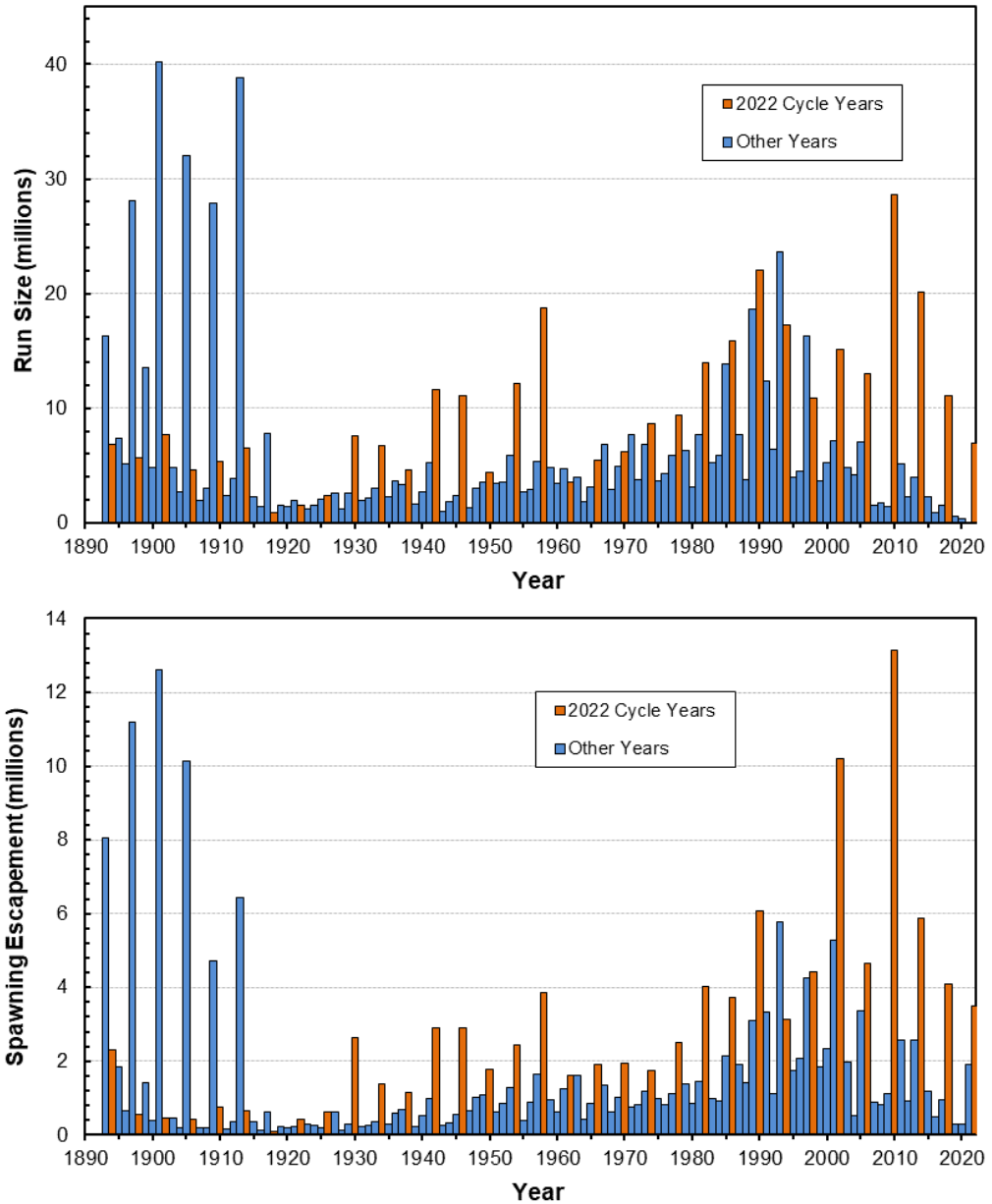


Figure 8. Total run size and spawning escapement of Fraser River sockeye salmon from 1893-2022. Returns on the 2022 cycle are shown in orange.

The returning abundances for all management groups were lower than pre-season expectations except for Early Stuart sockeye. A total of 244,200 Early Stuart sockeye adults (Table 7) returned, which exceeded the median forecast of 105,000 fish, and was the highest return on record for this cycle. Early Summer-run sockeye returns totalled 710,100 adults, 55% less than the median forecast level of 1,579,000. The dominant Early Summer-run component was the early timed component, which in turn was dominated by Nadina. The abundance of Summer-run sockeye was 3,856,300 adults, which was 12% less than the median forecast of 4,403,000 sockeye. Most Summer-run fish were from Chilko and Quesnel. Returning abundances to all Late-run stock components were low relative to their median forecasts except for Birkenhead-Big Silver sockeye. Predominantly due to the low abundance of Late Shuswap/Portage, Late-run had an aggregated return of 2,122,500 adults that was only 58% of the group's median pre-season forecast, and was the lowest return on this cycle since 1954.

Despite the better than expected returns, Early Stuart remained in a LAER throughout the season due to the adverse migration conditions and the high expected en-route losses. Lower than expected returns for Early Summer run resulted in that group also being managed in a LAER. For Late run, the uncertainty associated with the run size resulted in this group being managed in a LAER starting on August 22. By August 26, international TAC had become available again for the Late run group and gradually increased during the remainder of the season.

The total sockeye catch of 1,595,200 was about 23% of the run (Table 6). Of the total sockeye caught, 1,128,800 fish were caught in Canada, 352,300 fish in Washington, 73,000 in Alaska, and 41,100 fish in test fisheries (Table 6).

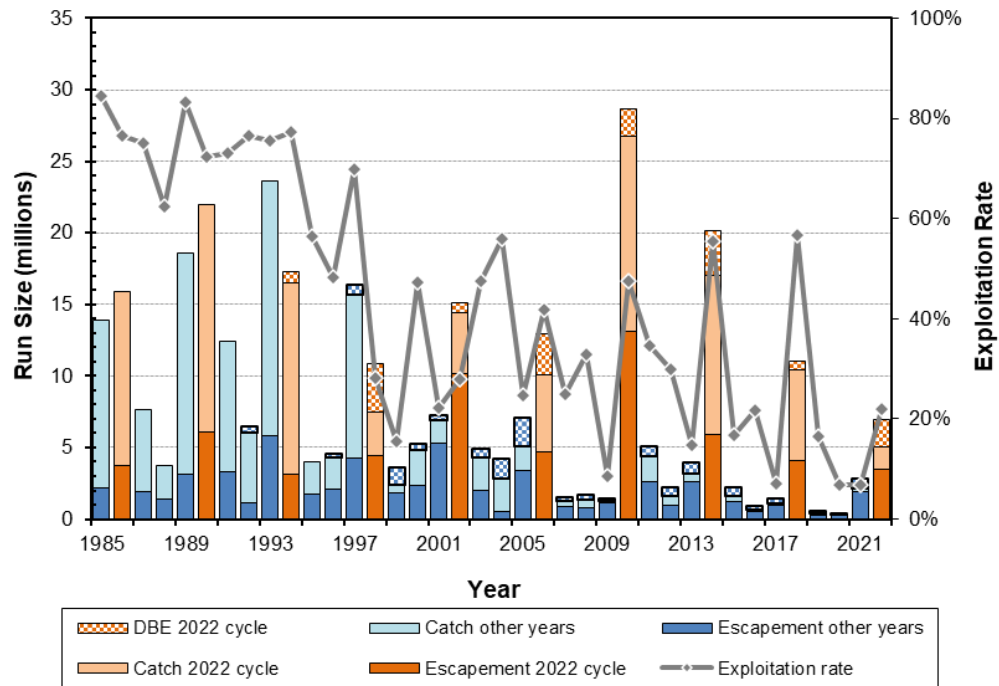


Figure 9. Total catch, escapement, difference between estimates, run size and exploitation rate for Fraser River sockeye salmon in 1985-2022, with returns on the 2022 cycle shown in orange.

Most of the Canadian catch was taken in First Nations Food, Social and Ceremonial (FSC) fisheries, with around 20% of the Canadian catch taken in commercial fisheries (including First Nations Economic Opportunity fisheries, Table 6). Within the commercial sector, most of the catch was taken in purse seines, followed by troll fisheries (Table 8).

In Washington State, 78% of the commercial catch (Table 6) was taken in Treaty Tribal fisheries and the remainder in All Citizen fisheries. Most fish were caught by purse seines, followed by gillnets and reefnets (Table 9). The Alaska catch of Fraser sockeye was estimated to be 73,000. In addition, 11,000 sockeye were caught in non-commercial ceremonial and subsistence Treaty Tribal fisheries.

DFO annually assesses the spawning ground abundance of sockeye populations in the Fraser watershed (Figure 10). In 2022, the near-final estimate of adult spawners (primarily age 4 and age 5 fish) totalled 3,511,900 fish (Table 7), or 51% of the total run. This escapement was 86% of the brood year (2018) escapement of 4,100,200 adults (Appendix G2).

Spawner abundances for all sockeye management groups were lower than those observed in the brood year (2018, Figure 11) except for the Summer run. Compared to cycle line medians, spawning escapements in 2022 were lower for the Early Stuart system, higher for the Early Summer- and Summer-run, but substantially lower for Late run.

The overall spawning success of adult female sockeye in the Fraser watershed was estimated to be 93%. The effective female spawning population in 2022 totalled 1,704,200 fish, which was 16% less than the number of effective females in 2018.

The total DBE estimate was 1,899,100 fish, or 27% of the total return. As a percentage of the run size, the Early Stuart management group had the largest DBE at 88% while the DBEs for the Early Summer-, Summer- and Late run management groups ranged from 11 to 27% (Table 6).

Further details regarding sockeye salmon abundances, catches and spawning escapements including comparisons with the previous four years on this cycle line can be found in Appendix G (Tables G1 and G2).

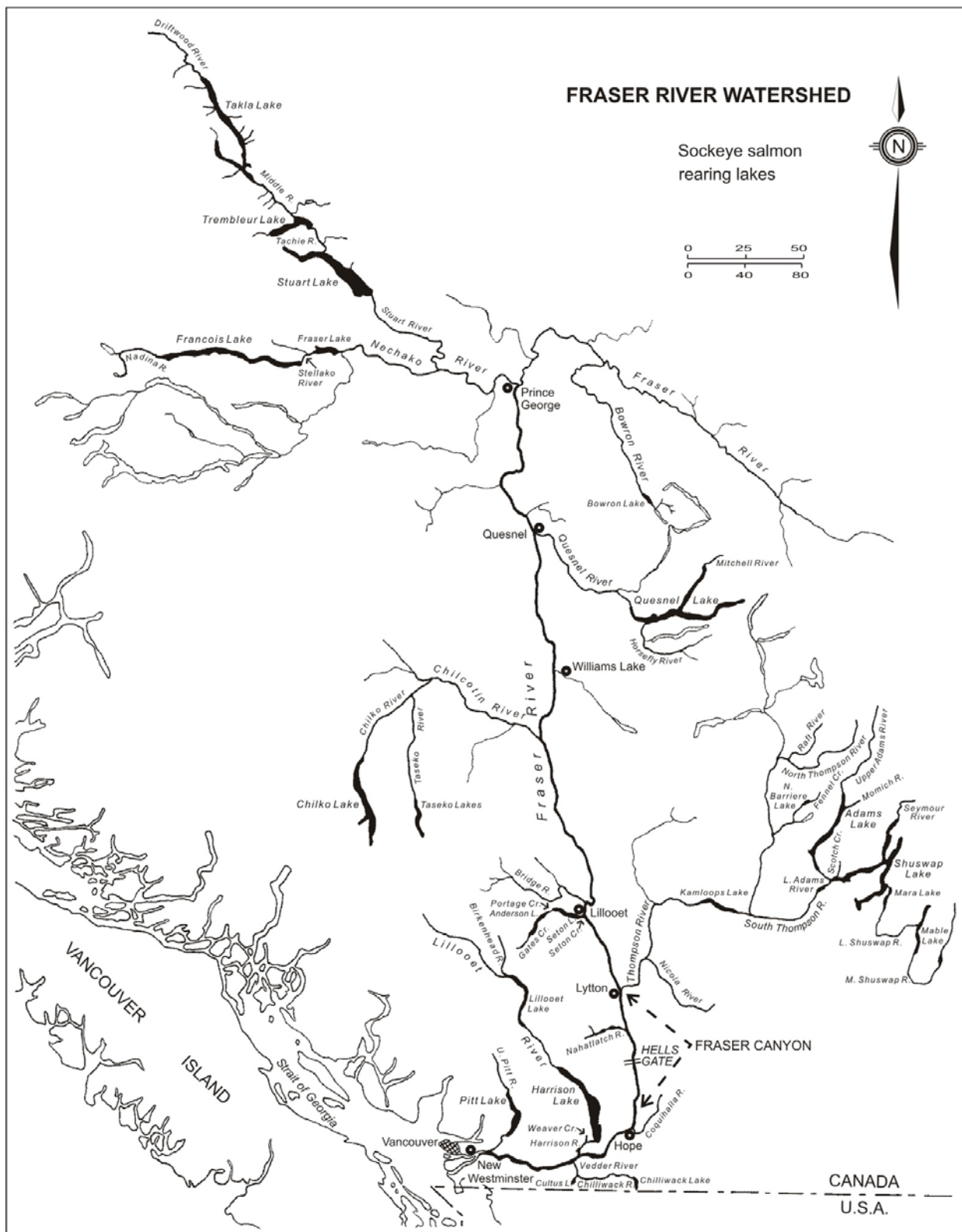


Figure 10. Sockeye salmon spawning areas in the Fraser River watershed.

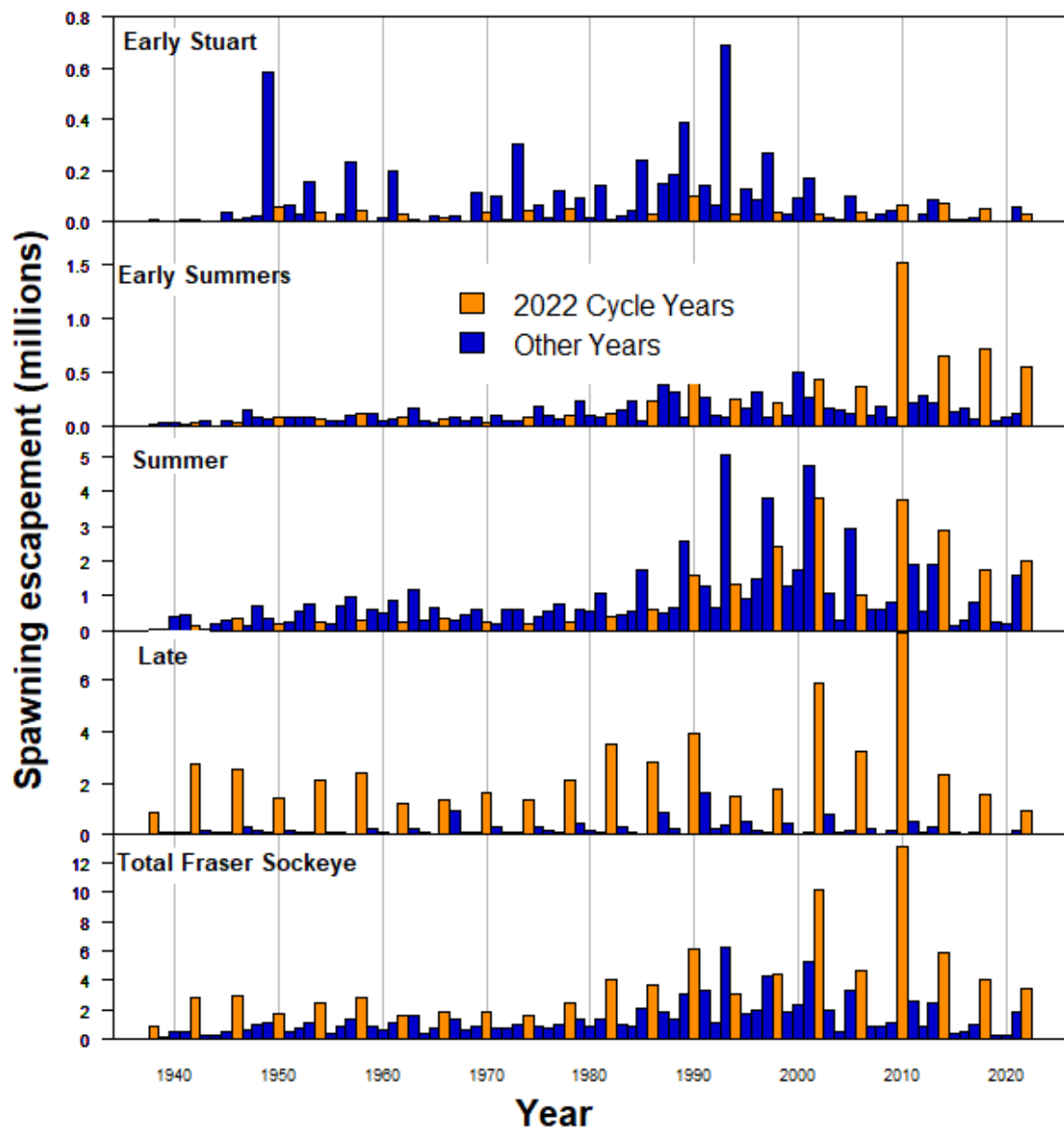


Figure 11. Annual adult spawning escapement of Fraser River sockeye salmon for each management group and for total sockeye in 1938-2022, with escapements on the 2022 cycle shown in orange.

Table 6. Catch, escapement, difference between estimates and run size for Fraser River sockeye salmon (by management group) in 2022.

	Fraser Sockeye				Total	% of Run
	Early Stuart	Early Summer	Summer	Late		
CANADIAN CATCH	3,700	58,200	628,900	438,100	1,128,800	16%
Commercial Catch	0	100	4,700	225,300	230,100	3%
Panel Area	0	90	3,800	224,800	228,700	3%
Non-Panel Areas	0	20	900	500	1,400	0%
First Nations Catch	2,300	45,100	412,100	70,900	873,400	12%
Marine FSC	100	10,400	201,200	119,200	331,000	5%
Fraser River FSC	2,300	45,100	412,100	70,900	530,400	8%
Economic Opportunity	0	0	400	11,500	12,000	0%
Non-commercial Catch	1,300	2,500	10,400	11,100	25,400	0%
Marine Recreational	0	10	300	600	900	0%
Fraser Recreational	0	50	5,400	9,500	15,000	0%
Charter (Albion & Area 12 Chum)	10	70	600	500	1,200	0%
ESSR	0	0	0	0	0	0%
Other Catch***	1,300	2,400	4,200	400	8,300	0%
UNITED STATES CATCH	1,000	21,700	258,600	144,000	425,300	6%
Washington Total	0	18,900	202,200	131,200	352,300	5%
Commercial catch	0	16,900	195,500	128,800	341,300	5%
Treaty Tribal	0	16,200	149,500	100,000	265,800	4%
All Citizen	0	800	46,000	28,800	75,500	1%
Non-commercial Catch	0	2,000	6,700	2,400	11,000	0%
Ceremonial	0	2,000	6,700	2,400	11,000	0%
Recreational	0	0	0	0	0	0%
Other Catch***	0	0	0	0	0	0%
Alaska	1,000	2,800	56,400	12,800	73,000	1%
TEST FISHING CATCH	1,100	6,500	22,500	11,000	41,100	1%
PSC (Panel Areas)	800	4,300	14,700	8,300	28,100	0%
Canada	800	4,200	14,600	8,300	28,000	0%
United States	0	40	60	10	100	0%
Canada (non-Panel Areas)	300	2,200	7,800	2,600	13,000	0%
TOTAL RUN	245,200	713,600	3,912,800	2,137,400	7,009,000	100%
Total Catch in All Fisheries	5,800	86,400	910,000	593,100	1,595,200	23%
Adult Spawning Escapement *	24,900	550,300	1,976,400	960,300	3,511,900	50%
Jack Spawning Escapement	0	700	100	2,000	2,800	0%
Difference Between Estimates**	214,500	76,300	1,026,300	582,000	1,899,100	27%
Percentage of Total Run	100%	100%	100%	100%	100%	
Total Catch in All Fisheries	2%	12%	23%	28%	23%	
Spawning Escapement	10%	77%	51%	45%	50%	
Difference Between Estimates	87%	11%	26%	27%	27%	

* Spawning escapement estimate for Cultus sockeye include 200 individuals captured as brood stock.

** 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 components of management groups.

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

Table 7. Catch, escapement, difference between estimates, run size and exploitation rate for Fraser River sockeye (by stock group) salmon in 2022.

Management Group Stock Group	Catch	Adult Spawning	Difference Between	Abundance			Portion of Run	Adult Exploitation Rate
		Escapement	Estimates ³	Adult	Jack ¹	Total		
Fraser Sockeye Salmon								
Early Stuart	5,800	24,900	214,500	245,200	0	245,200	3%	2%
Early Summer-run	86,400	550,300	76,300	713,000	700	713,600	10%	12%
Chilliwack	70	3,600	3,800	7,400	0	7,400	0%	1%
Early Miscellaneous	38,300	344,500	9,100	392,000	700	392,600	6%	10%
Early South Thompson	44,400	165,200	61,800	271,400	20	271,400	4%	16%
North Barriere/Taseko	2,400	7,200	1,700	11,300	0	11,300	0%	21%
Pitt	1,200	29,700	0	30,900	0	30,900	0%	4%
Summer-run	910,000	1,976,400	1,026,300	3,912,700	100	3,912,800	56%	23%
Raft/N.Thompson	6,400	9,600	50,600	66,600	0	66,600	1%	10%
Chilko	424,500	881,300	278,300	1,584,100	60	1,584,100	23%	27%
Quesnel	392,100	832,800	595,500	1,820,400	0	1,820,400	26%	22%
Late Stuart/Stellako	84,900	220,600	101,900	407,400	0	407,400	6%	21%
Harrison/Widgeon	2,000	32,100	0	34,200	40	34,200	0%	6%
Late-run	593,100	960,300	582,000	2,135,300	2,000	2,137,400	30%	28%
Birkenhead/BigSilver	29,500	131,000	44,500	205,000	2,000	207,000	3%	14%
Late Shuswap/Portage	449,600	730,900	317,100	1,497,700	20	1,497,700	21%	30%
Weaver/Cultus	113,900	98,400 ²	220,400	432,600	20	432,600	6%	26%
Total	1,595,200	3,511,900	1,899,100	7,006,200	2,800	7,009,000	100%	23%
Portion of Total Run	23%	50%	27%	100%	0%	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 Cultus sockeye include 200 individuals captured as brood stock.

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

Table 8. Canadian commercial catches of Fraser River sockeye salmon by gear type, license designation and statistical area in 2022. Grey areas indicate fishery areas are not part of the license-area designation.

Fishery Areas	Purse Seine		Gillnet			Troll			Total
	Area A	Area B	Area C	Area D	Area E	Area F	Area G	Area H	
Commercial	410	213,100	0	890	0	70	40	15,500	230,100
Panel Areas	0	213,100	0	0	0	0	20	15,500	228,700
20		0			0		0		0
17, 18, 29		213,100			0			15,500	228,700
121-124 *		0		0			20		20
Non-Panel Areas	410	0	0	890	0	70	20	0	1,400
1-10	410		0			70			490
11-16		0		890	0		0	0	890
124-127 *		0		0			20		20
First Nations Economic Opportunity and Demo Fisheries									12,000
Total Catch									242,100

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

Table 9. U.S. commercial catches of Fraser River sockeye salmon by user group, gear type and statistical area in 2022.

Areas	Purse				Total
	Troll	Seine	Gillnet	Reefnet	
Panel Area (Washington)	0	205,400	130,500	5,350	341,300
Treaty Tribal *	0	145,000	120,800	0	265,800
4B, 5 and 6C	0	0	9,810	0	9,810
6 and 7	0	91,200	22,000	0	113,300
7A	0	53,700	89,000	0	142,700
All Citizen **	0	60,500	9,670	5,350	75,500
7	0	36,200	3,790	5,350	45,400
7A	0	24,200	5,880	0	30,100
Alaska (District 104) Catch	0	0	0	0	0
United States Total					341,300

* Estimates for Treaty-Indian 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 (Appendix B, Table B2) for each management group, through the application of TAM rules (Total Allowable Mortality rates as a percentage of the total return) and deriving corresponding escapement goals.

In-season, the progress toward reaching spawning escapement targets can not be directly measured because in most cases spawner abundance cannot be assessed on the spawning grounds until well after the fishing season has ended. In-season management is therefore based on potential spawning escapement targets (i.e., PSE target = in-season spawning escapement target + MA). Progress towards these targets is monitored by comparison with in-season potential spawning escapement (PSE) estimates (i.e., Mission escapement to-date - catch above Mission).

Based on final in-season estimates, in-season PSE estimates were below PSE targets for Early Stuart (2% under) and Early Summer-run stocks (12% under) but exceeded the target for Summer

(31% over) and Late-run (14% over) stocks (Table 10). In-season, as the total run size estimate decreased due to lower than expected Early Summer, Summer, and Late-run returns, the available TAC decreased (Figure 12), resulting in the Panel constraining sockeye-directed fisheries.

Table 10. Comparison of in-season targets and in-season estimates of potential spawning escapement (PSE) for adult Fraser River sockeye salmon in 2022.

Management Group	Final	Potential Spawning Escapement (PSE)					
	In-season	Spawning Escapement Target	Management Adjustment *	In-season	PSE *** Estimate	Difference	
	Abundance Estimate			PSE ** Target			
Adult sockeye	6,806,000	3,578,000	3,420,300	4,452,900	5,276,000	823,100	18%
Early Stuart	244,000	195,200	2,594,200	244,000	239,000	-5,000	-2%
Early Summer	607,000	375,500	221,500	597,000	526,000	-71,000	-12%
Summer	3,805,000	1,902,500	361,500	2,264,000	2,969,000	705,000	31%
Late	2,150,000	1,104,800	243,100	1,347,900	1,542,000	194,100	14%

* 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.

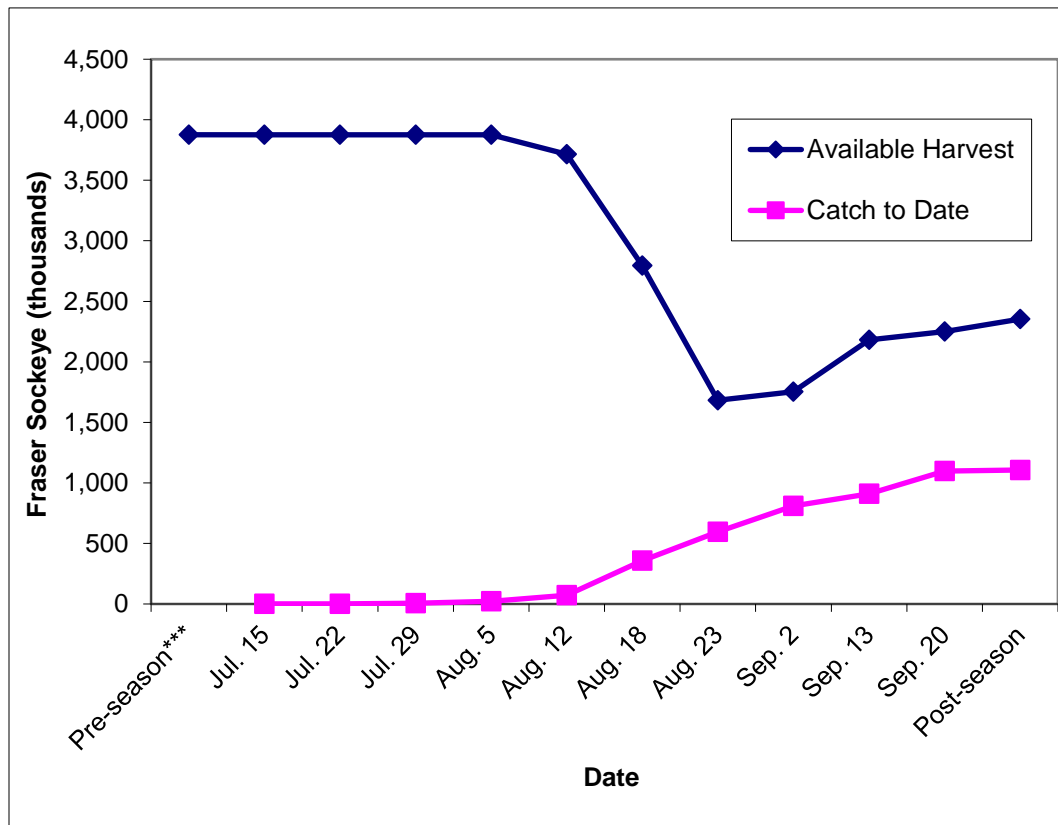


Figure 12. Available harvest of Fraser sockeye compared to catch to date in all fisheries in 2022. The available harvest is calculated as run size minus spawning escapement target and management adjustment and represents fish that are available for catch in all commercial, recreational, First Nations and test fisheries.

In terms of the achievement of post-season objectives, the total spawning ground escapement estimate of Fraser sockeye was 3% below the target (Table 11). Spawning ground escapement estimates were below their targets for Early Stuart and Late run, -87% and -13%, respectively; however, targets were exceeded for Early Summer and Summer run, 47% and 2%, respectively (Table 11). The spawning escapement for Early Stuart sockeye fell short of the target primarily because the target was most of the run and the observed DBE (-90%, Table 4) making the target unattainable. With DBEs of this magnitude, the run size would have to be much larger than observed to achieve the escapement target, even in the absence of fishing. For the Late-run sockeye, the shortfall was mainly due to the larger than predicted DBE (-38% observed, Table 4), which means that in-season management objectives did not sufficiently account for the expected loss of fish.

Table 11. Comparison of post-season spawning escapement targets and escapement estimates for adult Fraser River sockeye salmon in 2022. Post-season estimates of sockeye escapement are from spawning ground enumeration programs (Fisheries and Oceans Canada).

Management Group	Post-season Run-size Estimate	Spawning Escapement			
		Post-season Target	Adult Estimate	Difference	
				Fish	%
Sockeye salmon	6,936,000	3,603,900	3,511,900	-92,000	-3%
Early Stuart	244,200	195,400	24,900	-170,500	-87%
Early Summer	710,800	375,500	550,300	174,800	47%
Summer	3,856,400	1,928,200	1,976,400	48,200	2%
Late	2,124,600	1,104,800	960,300 *	-144,500	-13%

* Late-run escapement estimate includes 200 Cultus fish kept for broodstock.

B. International Allocation

The Panel's second priority is to achieve the goals for international allocation of the TACs 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 28). 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 are the post-season estimates, however.

Given the total in-season abundance estimate of 6,806,000 and deductions for spawning escapement, MA, test fishing catch and AFE, the International TAC for Fraser River sockeye salmon in 2022 was 1,981,400 (Table 12). The United States exceeded its share by 25,800 sockeye (Table 12). There was carryover payback of 470 sockeye from 2019 that was considered paid back by the end of the 2022 season. For Canada, the excess salmon to spawning requirements (ESSR) are excluded from catch totals when comparing them to the TAC. In 2022, the ESSR catch was 0 fish. Canada's catch of 1,128,500 Fraser sockeye fell 917,800 sockeye short of their allocated share of the International TAC plus their Aboriginal Fisheries Exemption (AFE) of 400,000. A detailed version of the TAC calculations by management group is presented in Appendix G, Table G3.

Table 12. Total allowable catch (TAC) and achievement of international catch shares for Fraser River sockeye salmon in 2022. 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 28), in accordance with the revised Annex IV, Chapter 4 of the Treaty agreed to in January 2020.

	<u>Sockeye</u>		
TOTAL ALLOWABLE CATCH			
In-season Total Run Size			6,806,000
Deductions			7,439,300
In-season Spawning Escapement Target			3,578,000
In-season Management Adjustment			3,420,300
Aboriginal Fishery Exemption (AFE)			400,000
Post-season Test Fishing Catch			41,100
Total Allowable Catch	1, 2		1,981,400
UNITED STATES			
Washington Total Share	3		326,500
Washington Share of TAC	1		326,900
Payback			-470
Washington Catch			352,300
Other Catch			0
Deviation			-25,800
In-season Alaska Catch Estimate			0
CANADA			
Canadian Share of TAC + U.S. Payback + AFE			2,054,900
Canadian Catch (excluding ESSR & Other Catch)			1,128,800
Other Catch	4		8,300
Deviation (excluding ESSR)			917,800

1

TAC and Washington sockeye share according to Annex IV, Chapter 4 of the Pacific

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

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.

With respect to domestic allocations of Fraser sockeye salmon, Treaty Tribal fishers in the U.S. caught 55,800 fish more than their share of the sockeye salmon TAC and All Citizen fishers caught 30,000 fish less (Table 13). There is no report of the domestic allocation for Canadian

commercial fisheries as allocations are often moved between fishers through the ITQ system or when some groups are unable to harvest their pre-season share due to a variety of reasons.

Table 13. Achievement of domestic catch goals in Washington for Fraser River sockeye salmon in 2022.

User Category	Actual Catch		Share of TAC		Deviation
	Fish	%	Fish	%	
Washington Total	352,320	105.8%	326,541	100.0%	25,800
Treaty Tribal *	276,820	78.6%	221,041	67.7%	55,800
All Citizen **	75,500	27.3%	105,500	32.3%	-30,000

* Treaty Tribal catch includes commercial and ceremonial catches.

** All Citizen catch includes commercial and recreational catches.

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 by-catch 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 by-catch 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. By-catches of non-Fraser sockeye salmon in commercial net fisheries regulated by the Fraser River Panel totalled 240 sockeye salmon. Catches of other Fraser and non-Fraser salmon species included 8,110 Chinook, 1,230 coho, 100 pink, and 140 chum (Table 14).

Table 14. Catches of non-Fraser sockeye and pink salmon and catches of other salmon species in commercial fisheries regulated by the Fraser River Panel in 2022.

Area and Gear	Non-Fraser		Fraser and Non-Fraser			
	Sockeye	Pink	Chinook	Coho	Chum	Steelhead
United States *	190	100	8,010	1,140	120	0
Areas 4B, 5 and 6C Net	60	20	3,830	870	110	0
Areas 6, 7 and 7A Net	130	90	4,180	270	10	0
Canada **	60	0	100	90	20	0
Area 20 Net	0	0	0	0	0	0
Area 29 Net	60	0	100	90	20	0
Total	240	100	8,110	1,230	140	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 no overage for Fraser River sockeye in 2022 (Table 15). The payback associated with pink directed fisheries in 2019 which caught 470 sockeye was considered paid back and would not be carried over to the 2023 season.

Table 15. Allocation status for Fraser River sockeye in 2018-2022. The allocation status is based on the TAC when the Panel makes its decision about the last U.S. fisheries.

	2018 (Aug 23)	2019 (Sep 13)	2020 (Sep 1)	2021 (Sep 28)	2022 (Aug 18)
TOTAL ALLOWABLE CATCH					
Total Run Size	14,022,000	500,000	293,000	2,553,000	7,274,000
Escapement and other deductions	7,822,400	500,000	293,000	2,377,260	4,940,480
Total Allowable Catch:	6,199,600	0	0	175,740	2,333,520
UNITED STATES					
Washington Catch	993,500	470	0	20	352,310
Washington Share (exclds payback)	1,020,300	0	0	29,000	385,030
Deviation:	-26,800	470	0	-28,980	-32,720
Cumulative Allocation Status:	0**	470**	470**	470**	0**
CANADA					
Catch	4,731,500	9,860	11,360	77,920	1,082,410
Share + Aboriginal Exemption	5,251,000	9,710	11,290	546,740	2,053,737
Deviation:	-519,500	150	70	-468,820	-971,327

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

- 2018: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks. Allocation status based on TAC when Panel made its last decision about U.S. fisheries in 2018 (Aug. 23), because TAC decreased between date of last U.S. fishery decision (Aug. 23) and when Panel adopted last in-season run size (Oct 12).
- 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).

VIII. POST-SEASON REVIEW

On August 18, 2022, the United States prosecuted a sockeye fishery that Canada objected to under the provisions of Annex IV, Chapter 4, paragraph 13(d)(iii). Pursuant to the same paragraph, the United States provided a rationale for the fishery via correspondence to the Panel's Canadian vice-chair on August 19, 2022 (U.S. rationale, Appendix H). On October 14, 2022, Canada corresponded with the Executive Secretary (Canadian response, Appendix H) requesting an objective report on the circumstances of the fishery and its consequences pursuant to Chapter 4, paragraph 13(e). The report addressed four central questions regarding 1) the appropriateness of the run size recommendations, 2) the appropriateness of the U.S. fisheries proposal made on August 18, 3) to what extent the U.S. took into account Canada's concerns, and 4) the consequences for planning subsequent fisheries. It concludes with Secretariat recommendations for improvements going forward. This report (Appendix H) prepared by PSC staff was submitted to the Panel December 2022 and reviewed at the PSC January 2023 post-season meeting. The report contained 13 recommendations to be considered by the Fraser River 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 2023 annual meeting.

VIII. 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 by-catch 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 by-catch 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: <u>A</u> <u>a</u> daptive <u>R</u> esolution <u>I</u> maging <u>S</u> onar	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: 2022 PRE-SEASON FORECASTS AND SPAWNING ESCAPEMENT TARGETS FOR FRASER RIVER SOCKEYE AND PINK SALMON

Table B1. Pre-season forecasts for Fraser River sockeye salmon in 2022. (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	<i>Ricker (Ei)</i>	39,000	63,000	105,000	172,000	268,000
Early Summer Total		384,000	764,000	1,579,000	3,159,000	5,686,000
Total excluding misc. stocks		196,000	370,000	757,000	1,474,000	2,769,000
Bowron	<i>Ricker (Ei)</i>	5,000	11,000	21,000	48,000	87,000
Upper Barriere (Fennell)	<i>Ricker (Pi)4/Sibling5</i>	800	2,000	4,000	9,000	19,000
Gates	<i>LLY4/Sibling5</i>	11,000	19,000	36,000	70,000	126,000
Nadina	<i>RickerFrDPk4/Sibling5</i>	51,000	100,000	193,000	381,000	703,000
Pitt	<i>LLY4/Sibling5</i>	13,000	21,000	35,000	58,000	89,000
Scotch	<i>Larkin4/Sibling5</i>	45,000	89,000	199,000	403,000	825,000
Seymour	<i>Ricker(Ei)4Sibling5</i>	70,000	128,000	269,000	505,000	920,000
Misc (EShu)	<i>R/S</i>	184,000	388,000	804,000	1,650,000	2,850,000
Misc (Taseko)	<i>R/S</i>	40	100	200	400	600
Misc (Chilliwack)	<i>R/S</i>	2,000	5,000	10,000	20,000	37,000
Misc (Nahatlatch)	<i>R/S</i>	2,000	4,000	8,000	15,000	29,000
Summer Total		1,239,000	2,231,000	4,403,000	8,904,000	17,468,000
Total excluding misc. stocks		1,237,000	2,223,000	4,387,000	8,872,000	17,402,000
Chilko	<i>Ricker(Ei)4/Sibling5</i>	482,000	806,000	1,463,000	2,662,000	4,732,000
Late Stuart	<i>Ricker(FrDMn)4/Sibling5</i>	80,000	184,000	458,000	1,091,000	2,520,000
Quesnel	<i>Ricker(Ei)</i>	485,000	917,000	1,907,000	4,178,000	8,531,000
Stellako	<i>Larkin4/Sibling5</i>	185,000	306,000	536,000	885,000	1,491,000
Harrison	<i>Ricker(Ei)Even3/Sibling4</i>	2,000	5,000	13,000	37,000	94,000
Raft	<i>LLY4/Sibling5</i>	3,000	5,000	10,000	19,000	34,000
Misc (N. Thomp.)	<i>R/S</i>	300	900	2,000	3,000	7,000
Misc (N. Thomp.)	<i>R/S</i>	2,000	7,000	13,000	28,000	57,000
Misc (Widgeon)	<i>R/S</i>	70	300	600	1,000	2,000
Late Total		711,000	1,604,000	3,688,000	8,160,000	18,285,000
Total excluding misc. stocks		709,000	1,597,000	3,672,000	8,132,000	18,234,000
Cultus	<i>PowerJuvPi</i>	400	600	1,000	3,000	5,000
Late Shuswap	<i>Ricker(Ei)</i>	645,000	1,473,000	3,418,000	7,582,000	17,166,000
Portage	<i>RickerCyc</i>	27,000	52,000	107,000	226,000	444,000
Weaver	<i>PowerJuv(Pi)4/Sibling5</i>	16,000	36,000	85,000	206,000	423,000
Birkenhead	<i>Ricker(Ei)</i>	21,000	35,000	61,000	115,000	196,000
Misc Harrison/Lillooet	<i>R/S</i>	2,000	7,000	16,000	28,000	51,000
TOTAL SOCKEYE SALMON		2,374,000	4,662,000	9,775,000	20,395,000	41,707,000
Total Sockeye excluding misc. stocks		2,181,000	4,250,000	8,921,000	18,650,000	38,673,000

Table B2. Spawning escapement plan for Fraser River sockeye and pink salmon in 2022. (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
Early Stuart	<i>lower ref. pt. (w misc)</i>	108,000	108,000	108,000	108,000	108,000
	<i>upper ref. pt. (w misc)</i>	135,000	135,000	135,000	135,000	135,000
	forecast	39,000	63,000	105,000	172,000	268,000
	TAM Rule (%)	0%	0%	0%	20%	20%
	Escapement Target	39,000	63,000	105,000	137,600	214,400
	MA	39,000	63,000	105,000	137,600	214,400
	Esc. Target + MA	78,000	126,000	210,000	275,200	428,800
	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	3,900	6,300	10,500	17,200	26,800
<u>2022 Performance</u>						
Projected S (after MA)		17,600	28,400	47,300	77,400	120,600
BY Spawners		48,489	48,489	48,489	48,489	48,489
Proj. S as % BY S		36%	59%	98%	160%	249%
cycle avg S		35,041	35,041	35,041	35,041	35,041
Proj. S as % cycle S		50%	81%	135%	221%	344%
Management Unit		Pre-season Forecast Return				
		p10	p25	p50	p75	p90
Early Summer (w/o RNT)	<i>lower ref. pt. (w misc)</i>	375,500	375,500	375,500	375,500	375,500
	<i>upper ref. pt. (w misc)</i>	751,000	751,000	751,000	751,000	751,000
	forecast (incl. misc)	383,840	764,100	1,579,200	3,159,400	5,685,600
	TAM Rule (%)	2%	50%	50%	50%	50%
	Escapement Target	375,500	382,050	789,600	1,579,700	2,842,800
	MA	221,500	225,400	465,900	932,000	1,677,300
	Esc. Target + MA	597,000	607,450	1,255,500	2,511,700	4,520,100
	LAER	20%	20%	20%	20%	20%
	Available ER at Return	0%	21%	20%	21%	20%
	Max. Allowable ER	20%	21%	20%	21%	20%
	Max. Allowable Harvest	76,800	156,700	323,700	647,700	1,165,500
<u>2022 Performance</u>						
Projected S (after MA)		194,200	383,900	793,100	1,586,100	2,853,700
BY Spawners		718,390	718,390	718,390	718,390	718,390
Proj. S as % BY S		27%	53%	110%	221%	397%
cycle avg S		350,379	350,379	350,379	350,379	350,379
Proj. S as % cycle S		55%	110%	226%	453%	814%

Table B2, continued on next page

Table B2, continued

Management Unit		Pre-season Forecast Return				
		p10	p25	p50	p75	p90
Summer (w. RNT & Har)	<i>lower ref. pt. (w misc)</i>	1,258,200	1,258,200	1,258,200	1,258,200	1,258,200
	<i>upper ref. pt. (w misc)</i>	2,516,300	2,516,300	2,516,300	2,516,300	2,516,300
	forecast	1,239,370	2,231,200	4,402,600	8,904,000	17,468,000
TAM Rule (%)		0%	44%	50%	50%	50%
Escapement Target		1,239,370	1,258,200	2,201,300	4,452,000	8,734,000
MA		74,400	75,500	132,100	267,100	524,000
Esc. Target + MA		1,313,770	1,333,700	2,333,400	4,719,100	9,258,000
LAER		20%	20%	20%	20%	20%
Available ER at Return		0%	40%	47%	47%	47%
Max. Allowable ER		20%	40%	47%	47%	47%
Max. Allowable Harvest		247,874	897,500	2,069,200	4,184,900	8,210,000
<u>2022 Performance</u>						
Projected S (after MA)		932,000	1,253,700	2,193,400	4,436,000	8,702,500
BY Spawners		1,750,333	1,750,333	1,750,333	1,750,333	1,750,333
Proj. S as % BY S		53%	72%	125%	253%	497%
cycle avg S		922,714	922,714	922,714	922,714	922,714
Proj. S as % cycle S		101%	136%	238%	481%	943%
Management Unit		Pre-season Forecast Return				
		p10	p25	p50	p75	p90
Late (w/o Har)	<i>lower ref. pt. (w misc)</i>	1,104,800	1,104,800	1,104,800	1,104,800	1,104,800
	<i>upper ref. pt. (w misc)</i>	2,209,600	2,209,600	2,209,600	2,209,600	2,209,600
	forecast	711,400	1,603,600	3,688,000	8,160,000	18,285,000
TAM Rule (%)		0%	31%	50%	50%	50%
Escapement Target		711,400	1,104,800	1,844,000	4,080,000	9,142,500
MA		156,500	243,100	405,700	897,600	2,011,400
Esc. Target + MA		867,900	1,347,900	2,249,700	4,977,600	11,153,900
LAER		20%	20%	20%	20%	20%
Available ER at Return		0%	16%	39%	39%	39%
Max. Allowable ER		20%	20%	39%	39%	39%
Max. Allowable Harvest		142,280	320,720	1,438,300	3,182,400	7,131,100
<u>2022 Performance</u>						
Projected S (after MA)		466,700	1,052,000	1,844,800	4,081,600	9,146,200
BY Spawners		1,584,836	1,584,836	1,584,836	1,584,836	1,584,836
Proj. S as % BY S		29%	66%	116%	258%	577%
cycle avg S		2,634,372	2,634,372	2,634,372	2,634,372	2,634,372
Proj. S as % cycle S		18%	40%	70%	155%	347%
Allowable Harvest (TF, US, CDN)		470,854	1,434,720	3,952,300	8,253,300	16,931,400
Total projected spawners		1,629,200	2,718,000	4,878,300	10,180,100	20,820,700

APPENDIX C: 2022 FRASER RIVER PANEL MANAGEMENT PLAN PRINCIPLES AND CONSTRAINTS (agreed July 12, 2022)

1. Fisheries and Oceans Canada (DFO) has provided the Panel with run-size forecasts for Fraser River sockeye salmon. It is broadly understood that the sockeye run-size forecasts are associated with high uncertainty due to high variability in annual salmon productivity (e.g., recruits/spawner, recruits/fry) and observation error in the associated data. The 50% probability level forecast for the total Fraser sockeye return is 9,775,000 fish. To put the sockeye run size forecast uncertainty into context, there is a one in four chance that the actual number of returning sockeye will be at or below 4,662,000 fish and there is a one in four chance that the actual number of returning sockeye will be at or larger than 20,395,000 fish. By stock grouping, the median or 50% probability forecasts are 105,500 Early Stuart, 1,579,000 Early Summer-run, 4,403,000 Summer-run, and 3,688,000 Late-run sockeye. The 50% probability level abundance forecasts for Fraser River sockeye salmon were used for pre-season planning purposes. When sufficient information is available in-season, the Panel will update run size estimates of Fraser River sockeye salmon, as appropriate.
2. The Panel's first priority is to obtain spawning escapement goals by stock or stock grouping. A coordinated approach to management has been developed that reflects both Parties sharing the burden of conservation. The US anticipates harvesting their full sockeye salmon total allowable catch (TAC).
3. TACs and international shares are calculated according to the 2020 revised Annex IV, Chapter 4, of the Pacific Salmon Treaty. Based upon the 50% probability levels of abundance, for the purposes of computing Fraser River sockeye TAC by stock management grouping in 2022, the Panel agreed to pre-season Fraser River Aboriginal Exemptions as determined by the process outlined in paragraph 3d. In situations where the allowable harvest of any Fraser sockeye salmon management group, according to Total Allowable Mortality rules as defined in Canada's escapement plan, is less than the harvest allowed under the low abundance exploitation rates (LAERs), the Panel will implement LAERs in order to allow access to the available TAC in other Fraser River sockeye salmon management groups. At the 50% probability forecasts, the LAERs are set at 10% for Early Stuart, 20% for Early Summer, Summer and Late-run sockeye. LAERs are not intended to create directed harvest opportunities in mixed stock areas and do not contribute to International TACs. Calculated International TACs that fall below the LAER amount will contribute to the International share.
4. The Panel has adopted a management approach for Late-run sockeye similar to recent dominant Late Shuswap return years that presumes a small portion of Late-run sockeye will enter the Fraser River earlier than the long-term average and suffer a higher en route mortality than later entering fish.
5. Given pre-season assumptions about Late-run sockeye marine timing and recent delay behavior, the Panel has agreed to use a proportional Management Adjustment (MA) factor for the aggregate (pMA) of 0.22.

Regulations

- i) If in-season conditions are consistent with pre-season expectations, low impact fisheries would be expected to commence in late-July 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) The Parties' conservation concerns for other species and stocks will be taken into account throughout the 2022 management season.

APPENDIX D: 2022 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 22, 2022.

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 salmon in Pacific Fishery Management Area 20-1, 3 and 4 with nets from the 26th day of June 2022, to the 17th day of September 2022, both dates inclusive.

b) No person shall troll commercially for sockeye salmon in Pacific Fishery Management Area 20-1, 3 and 4 from the 26th day of June 2022, to the 17th day of September 2022, both dates inclusive.
2. a) No person shall commercially fish for sockeye salmon in Pacific Fishery Management Areas 17 and 18 with nets from the 26th day of June 2022 to the 1st day of October 2022, both dates inclusive.

b) No person shall troll commercially for sockeye salmon in Pacific Fishery Management Area 18-1, 4 and 11 from the 26th day of June 2022, to the 1st day of October 2022, both dates inclusive.
3. a) No person shall commercially fish for sockeye salmon with nets in Pacific Fishery Management Area 29 from the 26th day of June 2022, to the 15th day of October 2022, both dates inclusive.

b) No person shall troll commercially for sockeye salmon in Pacific Fishery Management Area 29 from the 26th day of June 2022, to the 15th day of October 2022, 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 2022 season, the Fraser River Panel will adopt orders establishing open fishing periods based on a 2022 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 salmon in Puget Sound Salmon Management and Catch Reporting Areas 4B, 5 and 6C with drift gillnets or purse seines from the 26th day of June 2022 to the 17th day of September 2022, both dates inclusive.
2. No person shall commercially fish for sockeye salmon in Puget Sound Salmon Management and Catch Reporting Areas 6, 6A, 7 and 7A with nets from the 26th day of June 2022, to the 24th day of September 2022, both dates inclusive.
3. No person shall commercially fish for sockeye 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 18th day of September 2022, to the 8th day of October 2022, both dates inclusive.

All-Citizen Fisheries:

1. No person shall commercially fish for sockeye salmon in Puget Sound Salmon Management and Catch Reporting Areas 4B, 5, and 6C with nets from the 26th day of June 2022, to the 17th day of September 2022, both dates inclusive.
2. No person shall commercially fish for sockeye salmon in Puget Sound Salmon Management and Catch Reporting Areas 6, 6A, 7 and 7A with nets from the 26th day of June 2022, to the 24th day of September 2022, both dates inclusive.
3. No person shall commercially fish for sockeye 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 18th day of September 2022, to the 8th day of October 2022, 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 Point-Tatoosh Island Lighthouse Line.
2. Puget Sound Salmon Management and Catch Reporting Areas 6B, 6D, 7B, 7C, 7D and 7E.

During the 2022 season, the Fraser River Panel will adopt orders establishing open fishing periods based on a 2022 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: 2022 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.

July 29, 2022

United States

TREATY TRIBAL FISHERY:

Areas 4B, 5, and 6C: Open for drift gillnet fishing from 12 p.m. (noon) Monday, August 1, 2022 through 12 p.m. (noon) Wednesday, August 3, 2022.

August 2, 2022

United States

TREATY TRIBAL FISHERY:

Areas 4B, 5, and 6C: Extend for drift gillnet fishing from 12 p.m. (noon) Wednesday, August 3, 2022 through 12 p.m. (noon) Saturday, August 6, 2022.

August 5, 2022

United States

TREATY TRIBAL FISHERY:

Areas 4B, 5, and 6C: Extend for drift gillnet fishing from 12 p.m. (noon) Saturday, August 6, 2022 through 12 p.m. (noon) Wednesday, August 10, 2022.

August 9, 2022

United States

TREATY TRIBAL FISHERY:

Areas 4B, 5, and 6C: Extend for drift gillnet fishing from 12 p.m. (noon) Wednesday, August 10, 2022 through 12 p.m. (noon) Saturday, August 13, 2022.

August 12, 2022

United States

TREATY TRIBAL FISHERY:

Areas 4B, 5, and 6C: Extend for drift gillnet fishing from 12 p.m. (noon), Saturday, August 13, 2022 through 12 p.m. (noon), Wednesday, August 17, 2022.

Areas 6, 7, and 7A: Open for net fishing from 5 a.m., Saturday, August 13, 2022 through 9 a.m. Monday, August 15, 2022.

ALL CITIZEN FISHERY:

Areas 7: Open for reef net fishing from 5 a.m. through 9 p.m., Saturday, August 13, 2022.

August 16, 2022

United States

TREATY TRIBAL FISHERY:

Areas 4B, 5, and 6C: Extend for drift gillnet fishing from 12 p.m. (noon), Wednesday, August 17, 2022, through 12 p.m. (noon), Friday, August 19, 2022.

Areas 6, 7, and 7A: Open for net fishing from 5 a.m., Wednesday, August 17, 2022 through 9 a.m., Thursday, August 18, 2022.

August 18, 2022

United States

TREATY TRIBAL FISHERY:

Areas 4B, 5, and 6C: Extend for drift gillnet fishing from 12 p.m. (noon), Friday, August 19, 2022, through 12 p.m. (noon), Wednesday, August 24, 2022.

Areas 6, 7, and 7A: Open for net fishing from 5 a.m., Sunday, August 21, 2022 through 9 a.m., Monday, August 22, 2022.

ALL CITIZEN FISHERY:

Areas 7 and 7A: Open for purse seine fishing from 5 a.m. through 9 p.m., Saturday, August 20, 2022.

Areas 7 and 7A: Open for drift gillnet fishing from 8 a.m. through 11:59 p.m., Saturday, August 20, 2022.

August 23, 2022

United States

TREATY TRIBAL FISHERY:

Areas 4B, 5, and 6C: The previously announced drift gillnet fishery scheduled through 12 p.m. (noon), Wednesday, August 24, 2022 will now close at 12 p.m. (noon), Tuesday, August 23, 2022.

September 6, 2022

Canada

Area 29: Portions of Subareas 29-3, 4, 6 and 10 (seaward of the 45 meter depth contour): Open to Area B purse seine ITQ fishery from 6:00 a.m. to 9:00 p.m. daily from Thursday, September 8, 2022 until further notice (Please refer to DFO Fishery Notice for further details).

Subareas 29-1 to 6: Open to Area H troll ITQ fishery from 12:01 a.m. Thursday, September 8, 2022 until further notice (Please refer to DFO Fishery Notice for further details).

September 9, 2022

Canada

Area 29: Portions of Subareas 29-3, 4, 6 and 10 (seaward of the 45 meter depth contour): remains open to Area B purse seine ITQ fishery from 6:00 a.m. to 9:00 p.m. daily from Thursday, September 8, 2022 until further notice (Please refer to DFO Fishery Notice for further details).

Subarea 18-1 and Subareas 29-1 to 6: Area H troll ITQ fishery remains open from 12:01 a.m. Thursday, September 8, 2022 until further notice (Please refer to DFO Fishery Notice for further details).

United States

TREATY TRIBAL AND ALL CITIZEN FISHERIES:

Areas 4B, 5, 6, 6C, and 7: Relinquish regulatory control effective 11:59 p.m., Saturday, September 10, 2022.

September 13, 2022

Canada

Portions of Subareas 29-3, 29-4 (seaward of the 45 meter depth contour): Open to Area B purse seine ITQ fishery from 6:00 a.m. to 9:00 p.m. daily until Thursday, September 15. (Please refer to DFO Fishery Notice for further details).

Portions of Subareas 29-6, 29-10 (seaward of 45 meter depth contour): Open to Area B purse seine ITQ fishery from 6:00 a.m. to 9:00 p.m. daily until Sunday, September 18. (Please refer to DFO Fishery Notice for further details).

Subareas 29-1 to 5: Open to Area H troll ITQ fishery from 12:01 a.m. Wednesday, September 7, 2022 until 11:59 p.m. Thursday, September 22 (Please refer to DFO Fishery Notice for further details).

Subarea 18-1 and Subarea 29-6: Open to Area H troll ITQ fishery from 12:01 a.m. Wednesday, September 7, 2022 until 11:59 p.m. Sunday, September 25. (Please refer to DFO Fishery Notice for further details).

Fraser River Panel regulatory control over Canadian Panel Areas was relinquished in accordance with the pre-season regulations (Appendix D) as follows: Area 20 on September 17, Areas 17 and 18 on October 1, and Area 29 on October 15. Fraser River Panel regulatory control over United States Panel Areas was relinquished by in-season order on September 10 for Areas 4B, 5, 6, 6C, and 7; and in accordance with pre-season regulations (Appendix D) on October 8 for Area 7A.

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 salmon¹⁸. 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 2 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 2022.

Table F1. Sampling details for Panel-approved test fisheries conducted in 2022.

			2022						
Area	Name	Gear	Number of Vessels	Net Length (m)	Net Depth (meshes)	Mesh Size		Number of Sets	Set Duration (minutes)
Canadian Panel Areas						(mm)	(in)		
20	Juan de Fuca Str.	Gillnet	2	549	90	130	5 1/8	2	300
20	Juan de Fuca Str.	Purse Seine	1	549	875	95	3 3/4	6	20
29-1 to 6	Str. of Georgia	Troll	2	n/a	n/a	n/a		n/a	n/a
29-14	Fraser R. (Cottonwood)	Gillnet	1	220	Variable	Variable		2	20
29-16	Fraser R. (Whonnock)	Gillnet	1	320	Variable	Variable		2	20
United States Panel Areas									
5	Juan de Fuca Str.	Gillnet	1	803	220	130	5 1/8	2	400
7	San Juan Islands	Reefnet ¹	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
13	Lower Johnstone Str.	Purse Seine	1	397	575	95	3 3/4	6	20
	Fraser R. (Qualark)	Gillnet	1	30	Variable	Variable		6	5

¹ Reefnet observations are made during periods of favorable tides. Fish are counted as they swim through the gear but are not harvested.

¹⁸ 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.

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 by test fisheries in Area 13 (lower Johnstone Strait), U.S. Areas 4B, 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 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 2022, 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 2022 was forecast to have a high return of Fraser River sockeye, the Areas 4B,5 gillnet, Area 29 Gulf troll, and the Area 13 purse seine test fisheries were scheduled to operate.

The Whonnock gillnet was the first test fishery operational and began as planned on June 22. The Whonnock test fishery was extended by five days to October 9 as delaying sockeye continued to migrate into the Fraser River. The Cottonwood gillnet test fishery in Area 29 began on July 12 and ended on September 26 as scheduled. The Qualark gillnet test fishery was delayed due to high water and operated from July 15 to October 6. The Area 12 and Area 20 gillnet test fisheries began as planned on July 12 and July 10, respectively. These dates were after most of the Early Stuart sockeye were expected to have migrated past these test fishery locations. The Area 12 purse seine began as planned on July 24 and ended on September 4, seven days earlier than scheduled. The Area 13 purse seine test fishery began on July 26 and ended 25 days earlier than scheduled to reduce program costs and offset the extension of the Area 20 purse seine. The Area 20 purse seine test fishery began on July 25 and was extended until September 4. The Gulf Troll test fishery began on August 23 and completed five weeks of surveys for a total of 15 fishing days. The Area 4B, 5 gillnet start date was delayed and operated for three days between July 26 and July 29. The Area 7 reefnet observation test fishery operated for five days in July. Observers were present at Hells Gate five days per week, Sunday through Thursday, to confirm passage of sockeye through and upstream of the fishways.

Early in the season, marine gillnet daily catches of sockeye in Area 20 were consistent with brood year catches and lower than the cycle-year average. As the season progressed, catches in the Area 20 gillnet remained low and were lower than the brood year and the cycle-year average. Area 12 marine gillnet daily catches were consistently lower than the brood year and the cycle-year average throughout the season. Marine purse seine daily catches of sockeye in Area 20 were similar to the brood year earlier in the season, but then dropped below the brood year and remained similar to the cycle-year average. Catches in the Area 12 purse seine were slightly higher than the brood year and the cycle-year average. Catches at Cottonwood and Whonnock were both similar to the brood year but lower than the cycle-year average throughout the entire season. Catches in the Qualark test fishery were higher than the brood year and the cycle-year average.

Only sockeye that could not be released alive or those required for scientific samples were retained in the test fisheries and fish sales were unable to offset program costs. The 2022 program deficit of \$610,501 was paid for by the Test Fish Revolving Fund. The 2022 season was the final year of a four-year Southern Endowment Fund (SEF) project to evaluate the transition from a multistrand nylon gillnet to a more modern and readily available Alaska Twist gillnet in the Area 12 gillnet test fishery¹⁹. The experimental program ran for 34 days in 2022 and was fully funded by the SEF. The experimental program has concluded, and a final report will be generated for review. This was also the second year of a four-year SEF project to evaluate a transition from the

¹⁹ Labelle, M. and Van Will, P. 2023. Comparison of Sockeye Salmon catch and catch rates of two test-fishing gill nets used at Round Island in 2022. SEF Final Report.

Cottonwood test fishing location to a new location at Brownsville Bar²⁰. 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.

B. Mission Hydroacoustics

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

The Mission hydroacoustics site has applied a consistent sampling method, using a combination of split-beam and imaging sonars²¹, to enumerate salmon passage since 2011. In 2022, daily salmon passage was estimated using a side-looking split-beam sonar (S1) and an Adaptive Resolution Imaging Sonar (ARIS; A1) for the left bank of the river, a downward looking split-beam sonar (M) deployed from a mobile vessel for the offshore portion of the river, and an ARIS for the right bank of the river (A2; Figure F1). As in 2021, an ARIS was added as a secondary sonar on the vessel,²² with GPS location data included (M2). The sonar systems operate 24 hours per day to collect information on target density, direction of travel, speed, and size distributions. Sampling schemes and methodology for each sonar are described in detail in Chapters B11-B15 of the PSC Technical Report No. 49²³. Data from the mobile ARIS were not used to quantify escapement and were only used to validate fish behavioural statistics in the offshore region, including swimming direction, milling, and holding.

Operational dates for each system at Mission were as follows: A1, M, and M2 were deployed from July 1 to October 2; A2 was deployed July 29 to October 1; and S1 was deployed from August 8 to October 2. Due to high water S1 and A2 were deployed at different dates preventing normal system deployment. During high water, A1 was deployed on a tripod (July 1 – August 7) and A2 was subsampled in 3-hour increments from an anchored vessel (July 1 – July 28). To calculate daily passage on the right bank, the ratio of A2/A1 during the 3-hour sampling period was applied to 24-hour A1 passage. For days without right-bank sampling, passage was calculated using the ratio of A2/A1 from the previous day and applied to the A1 passage of the current day. A2 was permanently deployed on July 29, and both A1 and S1 were permanently deployed on the fish weir on August 8.

²⁰ Sutherland, B., Baltzell, M., Jantz, L., and A. Fisher. 2023. Lower Fraser River Gillnet Test Fishery Site Evaluation. SEF Final Report.

²¹ 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.

²² 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.

²³ 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.

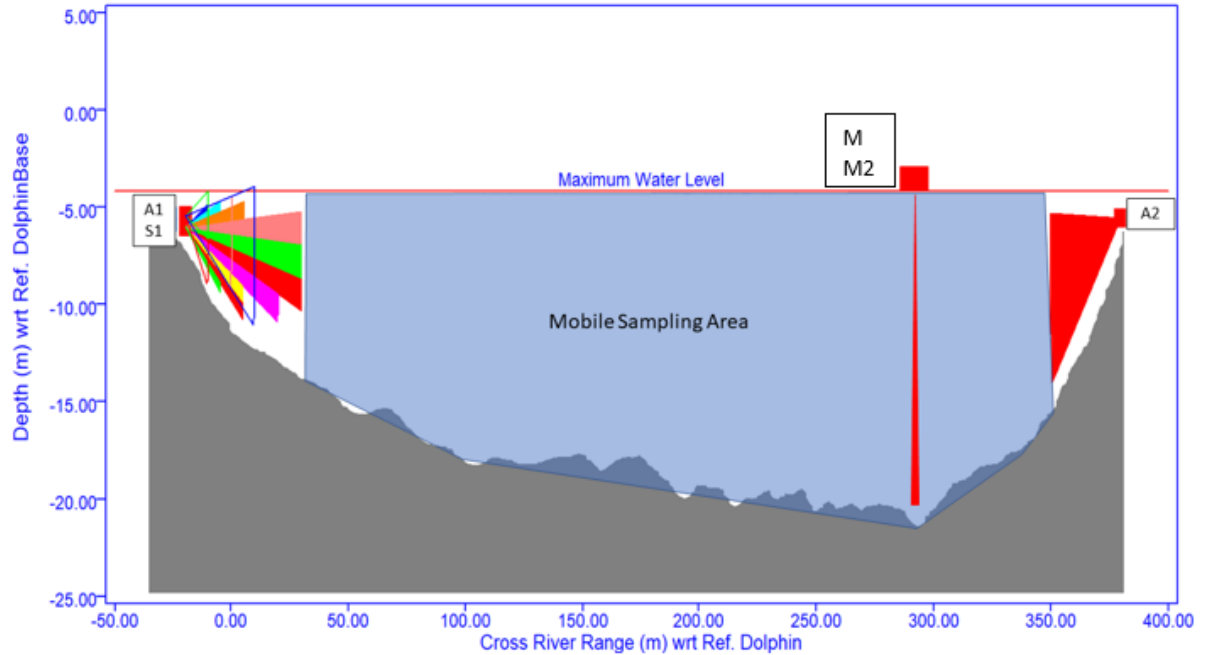


Figure F1. Cross-river view of the sampling geometry of the sonar systems operated at the Mission hydroacoustics site. The five systems shown are the left bank split-beam (S1), the left bank ARIS (A1), the mobile split-beam (M), the mobile ARIS (M2), and the right bank ARIS (A2). The beam geometries 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 M (and M2). 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.

Salmon passage estimates from each system (A1, S1, M, A2) were combined to obtain daily total salmon passage. Overlapping sampling areas between the vessel-based split-beam and shore-based systems were identified using GPS, and passage from the shore-based systems were preferentially adopted. Relative to the shore-based systems, vessel-based split-beam estimates are less precise due to lower sampling intensity and are prone to negative bias due to avoidance behaviour²⁴. In the left-bank area, A1 was used to estimate salmon passage up to a 30-metre range, and S1 was used to estimate salmon passage from 30 to 50m. Over the entire monitoring period from July 1 to October 2, the A1 and S1 left bank systems saw a combined 75% of total salmon passage, the right bank A2 observed 15% of passage, and the offshore system, M, observed 10% of passage.

New in 2022, in accordance with the signed Memorandum of Understanding (MOU) between the PSC, Fisheries and Oceans Canada, and Sumas First Nation, the vessel was docked during Food, Social, Ceremonial (FSC) drift net fisheries at Mission. To interpolate missing data and account for changes in fish behaviour during drift net openings (mean opening = 8 hours), a linear

²⁴ 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.

or non-linear interpolation was performed; otherwise known as the Mission data imputation²⁵. Of the 94 days that Mission was in operation, 17 fishery openings occurred.

Species Composition

Species composition estimates are essential for translating lower river hydroacoustic estimates of daily fish passage estimates into stock-specific estimates²⁶. 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^{27,28}. 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, or Chinook salmon, which are more prevalent offshore, a stratified approach is applied using a combination of different offshore versus near-shore species composition methods. When available, species composition comparisons are also made with other upriver assessment programs, such as fish wheels.

In 2022, abundances in the Fraser River were expected to be dominated by sockeye salmon with exception of the early part of the season when Chinook abundances might be relatively large in comparison to Early Stuart and Early Summer run abundance. From July 1 – October 2, sockeye abundance was estimated by subtracting estimates of other salmon from the total hydroacoustic estimate. Prior to July 1, and after October 2, sockeye abundance was estimated using Whonnock CPUE data as hydroacoustic systems were not in operation. Prior to September 1, salmon passage was divided between sockeye and Chinook. A combination of methods was used to determine daily Chinook abundance, including: historical average daily abundance, median daily abundances from the pre-season forecast (provided by Chuck Parken, DFO), or estimates derived from Albion test fishery CPUE and a historical estimate of catchability. From September 1 – October 9, estimates of chum and coho were also removed from daily total salmon passage using Albion CPUE data. Post-season the coho expansion line was updated based on the Albion CPUE and historical coho salmon escapement estimates. This resulted in a post-season revision to the Mission hydroacoustic estimates.

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 catches²⁹. Stock

²⁵ 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.

²⁶ 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, 145-150 p.

²⁷ 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.

²⁸ Martens, F.J., Michielsens, C., Scroggie, J., Staley, M., Whitehouse, T., Wor, C., and Xie, Y. 2019. Hydroacoustics Review Technical Summary. Pacific Salmon Comm. Tech. Rep.: 41, 369 p.

²⁹ 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.

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 salmon in 2022 used DNA and scale pattern analyses from fish caught in marine and in-river fisheries³⁰. No stock composition estimates were produced for pink salmon in 2022 because the Fraser River pink salmon run is virtually non-existent in even numbered years. For sockeye salmon, continuing a practice developed in recent years, a multinomial extrapolation procedure was used for predicting stock composition estimates in catches that had not yet occurred or had not yet been analyzed.

A. Sockeye Salmon

Stock identification methods for sockeye salmon relied on DNA and scale pattern analyses³¹. Both techniques 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”)³². 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, Tofino on Vancouver Island, Vancouver, and Richmond, B.C.). Additionally, A-Tlegay Fisheries Society provided commercial fishery samples from Campbell River while DFO provided samples from test fisheries in Johnstone Strait and from 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 476,385 sockeye. Extracted DNA of fish putatively originating from southern stocks (as determined by examination of Single Nucleotide Polymorphisms³³ 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 73,006.

The forecast for the Late-run management group was 38% of the total Fraser River sockeye. At the end of the season, the Late-run group made up 30% of total sockeye returning to the Fraser Panel Area. Figures F2 and F3 illustrate Late-run stock proportions estimated in Juan de Fuca Strait and Johnstone Strait, respectively, as they changed throughout the management season. There was considerable variance among samples within both approach routes. Samples obtained from commercial gillnet fisheries in Area 13 at the end of the season had a higher Late run proportion than indicated by the Area 12 purse seine samples from the same time period. In general, Late-run stock proportions increased steadily between late July to mid-August. In both approaches, Late-run proportions peaked around August 17 (Area 20 date), after which stock

³⁰ 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.

³¹ Gable, J. and S. Cox-Rogers. 1993. Stock identification of Fraser River sockeye salmon: methodology and management application. PSC Tech. Rep. No. 5.

³² 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.

³³ 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.

proportions declined until the termination of test fisheries. Similarly in 2018, Late-run proportions increased starting in the first week of August and peaked around August 19.

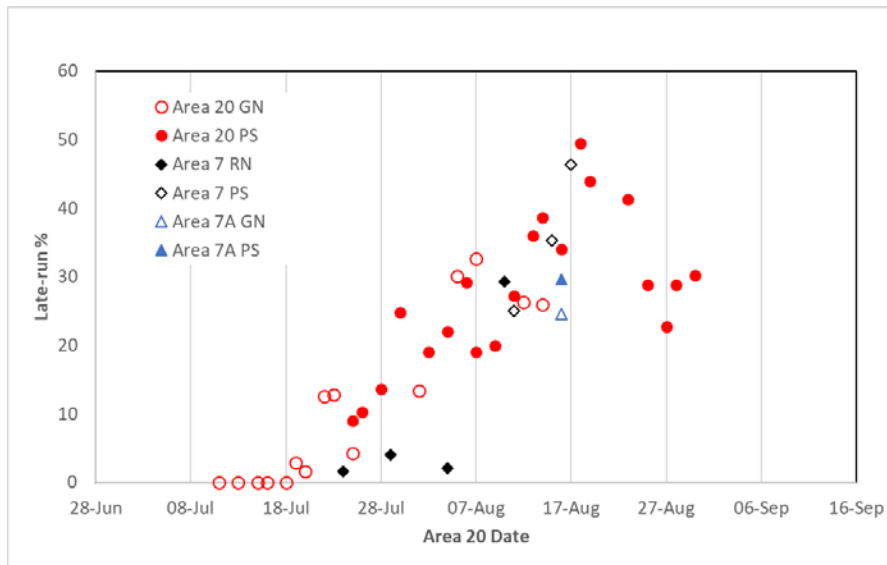


Figure F2. Late-run stock proportions in Juan de Fuca Strait fisheries (GN: gillnet; PS: purse seine; RN: reefnet). Area 20 date is the date at which the sampled fish would have been or were estimated to be near Port Renfrew waters in the Salish Sea, which may differ from the actual sampling date because of the location of the catch. The estimated common Area-Date facilitates comparisons of stock proportions across different sampling areas. When the catch spanned multiple days, the median date was used to calculate the corresponding Area 20 date.

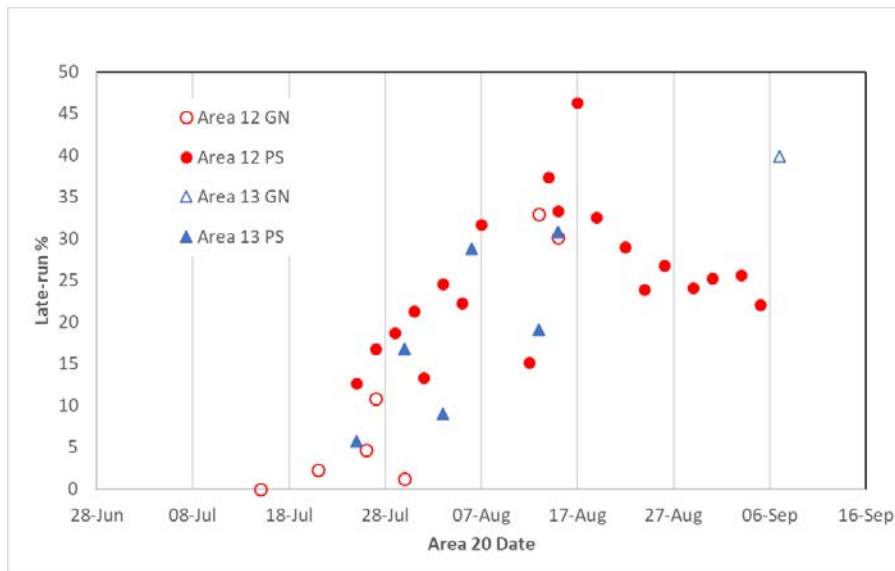


Figure F3. Late-run stock proportions in Johnstone Strait fisheries (GN: gillnet; PS: purse seine). Area 20 date is the date at which the sampled fish would have been near Port Renfrew waters in the Salish Sea if they migrated through Juan de Fuca Strait.

Other research, extending an approach tried during the 2014 and 2018 management seasons, a Smolt Method for Updating Run Figures³⁴ (called SMURFing) was used to provide an independent estimate of total Late-run abundance. Ratios of Late Shuswap/Portage to Early Thompson stocks were examined among samples of outmigrant juveniles collected in Area 12 and Area 13 in 2020. These juvenile samples were collected by the Hakai Institute and Raincoast Research Society, and DNA results were shared with the PSC. Due to COVID, programs typically run by DFO to estimate juveniles were not operational. Juveniles of both stock groups rear predominantly in Shuswap Lake and are assumed to be similar in body size, behaviour, and age-at-maturity. It was therefore hypothesized that they would be equally vulnerable to sampling gear and would survive at similar rates to return as age-four fish in 2022. The average ratio of Late Shuswap/Portage to Early Thompson stocks across all the outmigrant juvenile samples was 3.2, which was applied to the in-season run-size estimate of Early Thompson to generate an estimate of the Late Shuswap/Portage run. This estimate was independent of the reconstruction-based run size estimate. The first in-season SMURFing estimate of Late Shuswap/Portage on August 18 was 0.9 million (80% PI: 0.7 million – 1.3 million). One week later (August 23), the SMURFing estimate was 0.85 million (80% PI: 0.6 million – 1.2 million) which was associated with a ratio of Late Shuswap/Portage to Early Thompson of 3.1:1. The end-of-season ratio of Late Shuswap/Portage to Early Thompson was nearly 6:1.

Each year during the 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 PSC 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. On the dominant Late Shuswap cycle, typically the age composition is dominated by age-four sockeye, and this was observed across most stocks in 2022. The age-four forecast for returning Early Stuart sockeye was similar to the observed proportion of age-four fish in fishery samples collected in 2022. For most of the Early Summer stocks, the age-four forecast was similar to the observed proportion of age-four fish. Within the Summer run group, the observed Late Stuart/Stellako age-four proportion was less than the forecast whereas a higher age-4 proportion than forecast was observed for Quesnel sockeye. Within the Late run group, Birkenhead had a higher observed age-four proportion than forecast, while Weaver had a lower observed age-four proportion relative to forecast. The age-four proportion for Late Shuswap/Portage was similar to the forecast.

³⁴ Latham, S. and C. Michielsens. 2022. In-season SMURF 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, 167-172 p.

Table F2: Summary of the 2022 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	2022 Fraser Sockeye Forecasts			2022 In-season	
	Median Age-4 Forecast	Total Median Forecast	% Age-4	Sample size	% Age-4
Early Stuart	100,000	105,000	95%	248	98%
Chilliwack	5,000	10,000	50%	12	100%
Pitt	7,000	35,000	20%	38	21%
Nadina	191,000	193,000	99%	682	98%
Bowron	20800	21,000	99%	12	100%
Nahatlatch	5,000	8,000	63%	16	63%
Gates	32,000	36,000	89%	15	40%
Taseko	190	200	95%	3	100%
North Barriere	3,400	4,000	85%	10	100%
Early S. Thompson	1,270,000	1,272,000	100%	291	99%
Early Summer	1,534,390	1,579,200	97%	1,079	94%
Harrison	12,100	13,000	93%	30	94%
Widgeon	300	600	50%	0	NA
Late Stuart/Stellako	928,000	994,000	93%	342	87%
Chilko	1,378,000	1,463,000	94%	1,572	95%
Quesnel	1,772,000	1,907,000	93%	1,395	100%
Raft/North Thompson	16,300	25,000	65%	29	86%
Summer	4,106,700	4,402,600	93%	3,368	96%
Birkenhead	26,000	61,000	43%	201	81%
Misc. Lillooet-Harrison	3,000	16,000	19%	4	100%
Late Shuswap/Portage	3,523,600	3,525,000	100%	603	99%
Weaver	70000	85,000	82%	346	77%
Cultus	800	1,000	80%	3	100%
Late	3,623,400	3,688,000	98%	1,157	89%
Total	9,364,000	9,775,000	96%	5,852	94%

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 catches³⁵ 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^{36,37,38,39}. These

³⁵Michielsens, C.G.J. 2022. 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.

³⁶Pacific 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.

³⁷Pacific 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.

³⁸Michielsens, 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>.

³⁹Michielsens, C.G.J. 2022. 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.

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.

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. Consequently, two standard alternative sources of Late-run stock assessment data are regularly evaluated to provide more information on dominant cycle lines. Prior to Late-run arrival, a preliminary estimate of abundance is produced using a Bayesian model fit to the historical ratio of Late Shuswap/Portage to Early Thompson juveniles and in-season estimates of the adult Early Thompson return⁴⁰ (SMURF model, Appendix F). Later in the season, when a portion of Late-run migrants have entered the Strait of Georgia, CPUE data from the Gulf Troll test fishery is used to estimate the abundance of delaying Late-run fish temporarily residing in the Strait prior to commencing their upstream migration⁴¹. The estimate of delaying abundance is then added to estimates of seaward abundances, lower river catch, and Mission escapement to derive an estimate of total run size.

In 2022, an additional approach was used to provide alternative run size estimates for the non-Birkenhead Late-run component due to concerns regarding data limitations in the SMURF model and uncertainty in the Gulf troll-based estimates. A linear regression was fit to historical annual purse seine test fishery catchabilities for non-delaying Summer and Late run stocks on the dominant cycle line. The R^2 , or co-efficient of determination, for the regression was 0.89, indicating a strong relationship between Summer and Late run expansion lines. The model was used to estimate the annual Late-run catchability based on in-season estimates of Summer-run CPUE and run size. The non-Birkenhead Late-run run size was then estimated by dividing the total cumulative purse seine CPUE by the projected annual catchability estimate. Annual catchabilities are generally more robust and subject to fewer assumptions than the daily expansion lines; however, this model can only be applied late in the season when there is a firm estimate of Summer-run run size and catchability and the purse seine test fisheries have concluded (i.e. CPUE estimates are complete and reflective of the entire run).

Figures F4 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 2022, pre-season forecasts overestimated the run size for all management groups except for Early Stuart.

⁴⁰Latham, S. and Michielsens, C.G.J. 2022. 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. 167-172.

⁴¹Hague, M.J. and C.G.J. Michielsens. 2022. Gulf troll-based run size. 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. 173-178.

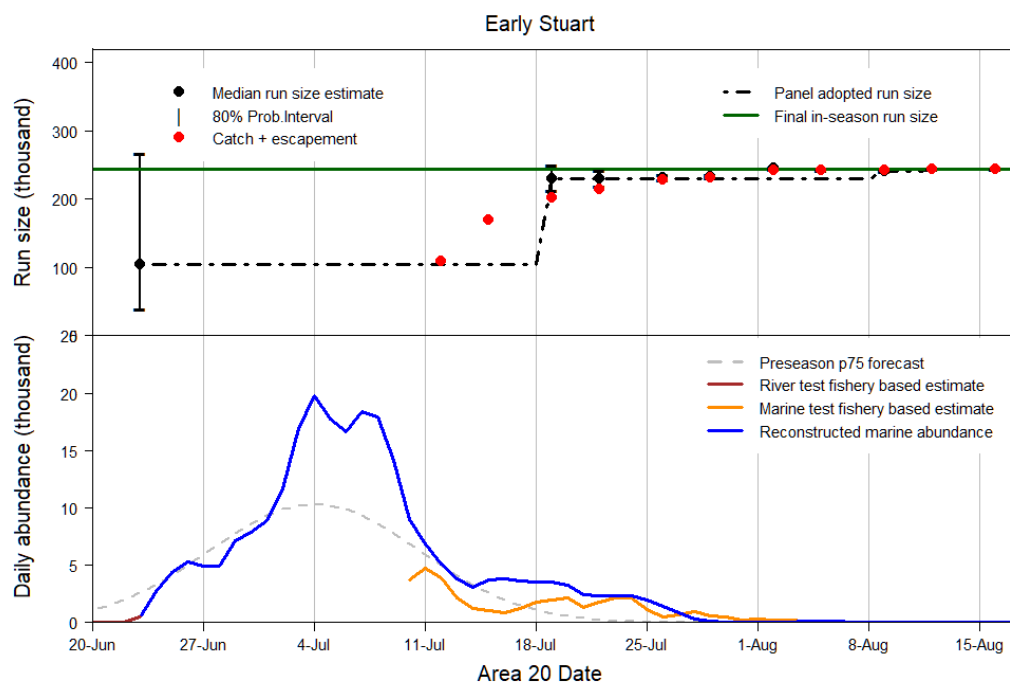


Figure F4a: Daily reconstructed abundance estimates for Early Stuart and corresponding run size estimates at different times during the season.

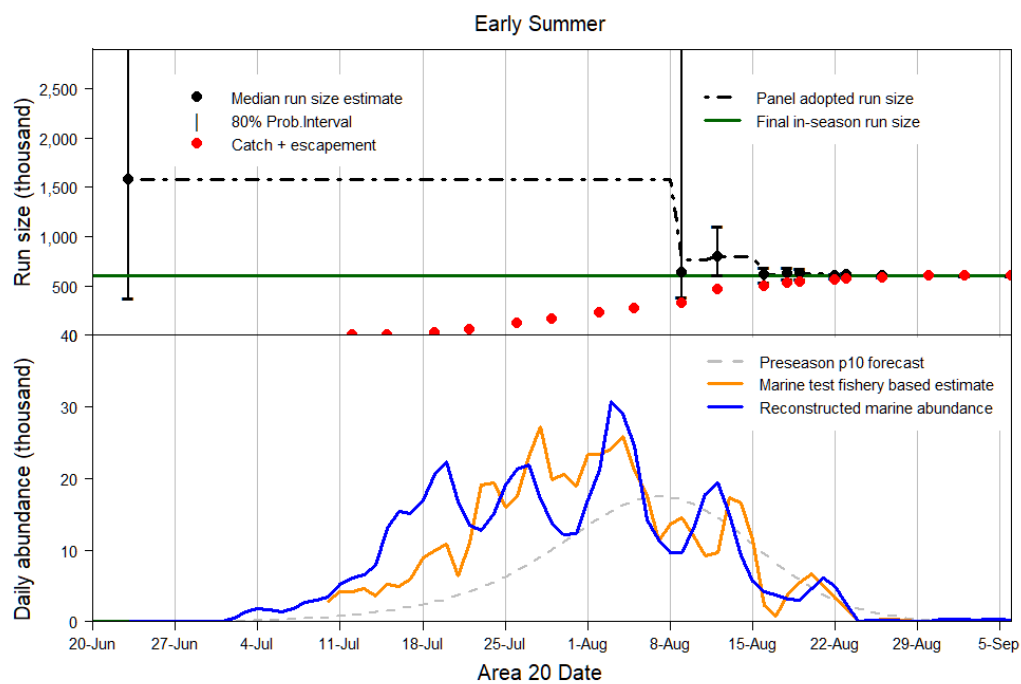


Figure F4b: Daily reconstructed abundance estimates for Early Summer-run salmon and corresponding run size estimates at different times during the season.

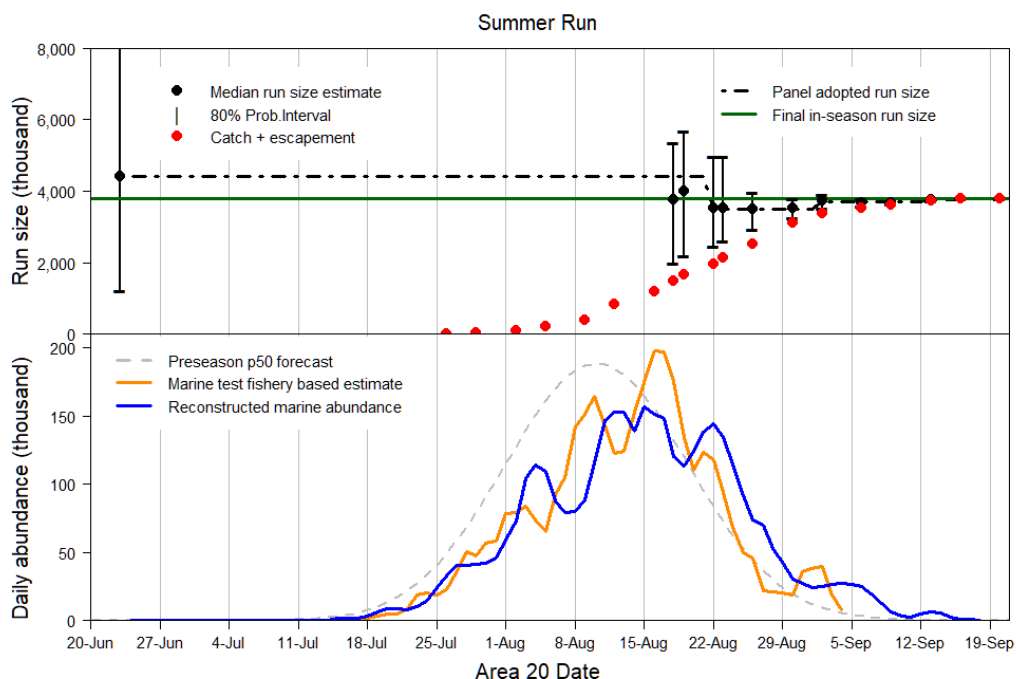


Figure F4c: Daily reconstructed abundance estimates for Summer-run salmon and corresponding run size estimates at different times during the season.

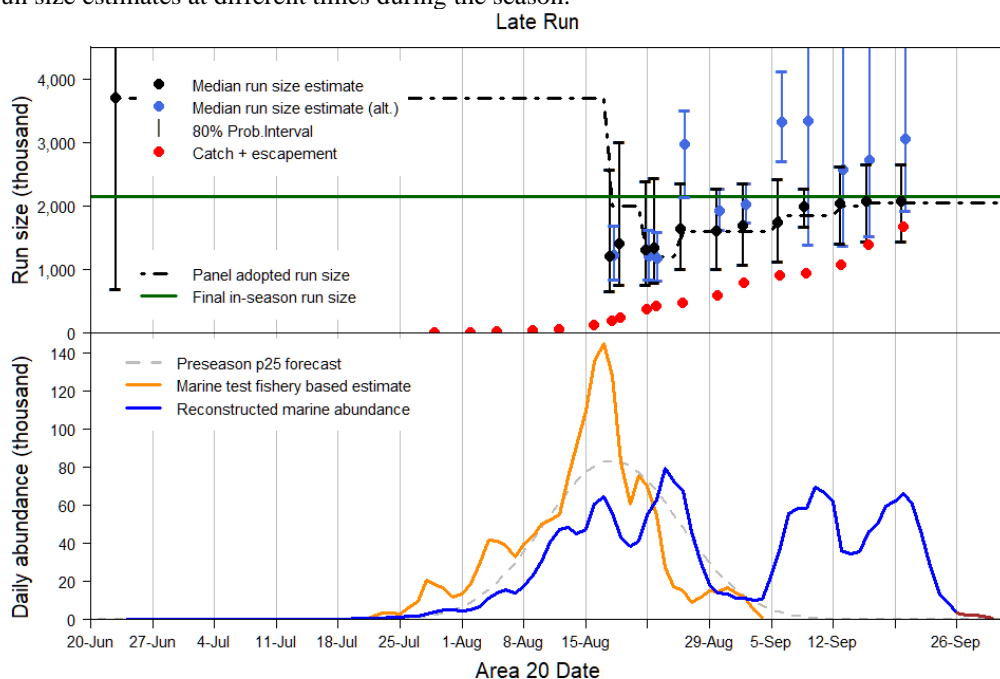


Figure F4d: Daily reconstructed abundance estimates for Late-run salmon and corresponding run size estimates at different times during the season.

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 based on

the relationships between winter snowpack accumulation, summer air temperatures and river environmental conditions. The forecast was for above average discharge and below average to average water temperature in the Fraser River. The environmental forecast was used to populate a series of Environmental Management Adjustment (MA) models⁴². A retrospective analysis was used to identify the models that would generate the best prediction of the proportional difference between estimates (pDBE) (Table F3).

Table F3. 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 ¹		In-season Best Performing Model 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 Predictions ³	
	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA
Early Stuart	-50%	1.00	-93%	13.29	-75%	3.00	-90%	9.00	-84%	5.25	NA	NA
Early Summer run	-37%	0.59	-37%	0.59	-33%	0.49	-43%	0.75	-43%	0.75	NA	NA
Summer run	-4%	0.04	-4%	0.04	-4%	0.04	-27%	0.37	-31%	0.45	NA	NA
Late run	-18%	0.22	-18%	0.22	NA	NA	NA	NA	NA	NA	-35%	0.54

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. 16th.

The Panel chose to adopt the proportional Management Adjustments (pMAs) (see Table 4) based on the best preseason and in-season pDBE forecast method identified in the retrospective analysis (see Table F4). For both the pre-season and in-season approaches the retrospective analysis evaluated the performance of the different pDBE forecast methods since 2010 by comparing the pDBE estimates with the observed value. Assuming there may be trends in pDBE estimates over time, the retrospective analysis also evaluated the use of data sets of different lengths, using data up to the year for which a prediction is made. Two performance measures were used: Mean Raw Error (MRE) and Mean Absolute Error (MAE).

Table F4. Best performing pDBE approach identified by the retrospective analysis of the pre-season and in-season approaches for each management group.

	Pre-season recommended method	In-season recommended method
Early Stuart	Median (1995-2021)	Supplemental Approach (1977-2021)
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

For pre-season planning purposes, the retrospective analysis of the different pDBE approaches identified the best performing model for Early Stuart was the median pDBE of a shorter dataset (1995-2021) but it still slightly underestimated the pDBE. For Early Summer run, the best and most balanced approach relied on the All-years median (1977-2021). The pre-season pDBE Model using the pre-season long-range forecast provided by E-Watch was ranked the best

⁴² 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

performing forecast method for the Summer run. For Late run, using the Dominant year Median on a Dominant cycle year was ranked the best performing forecast method for the 2022 (Dominant cycle) season. Figure F5a, b, c and d provide an overview of the performance of the pre-season pDBE approaches for each management group. Based on the pre-season adopted pMAs (Table 4), Management Adjustments (MAs) of 105,000 Early Stuart, 465,900 Early Summer, 88,100 Summer and 405,700 Late-run sockeye were added to the spawning escapement targets (SET) for pre-season planning purposes. Although a management adjustment was adopted for Early Stuart, the spawning escapement target (SET) was its entire run size at the median forecast abundance level. This SET, coupled with the application of a LAER and the pre-season adopted proportional management adjustment (pMA) of 1.00, meant that spawning escapement targets for the Early Stuart were unlikely to be reached.

The retrospective analysis of the in-season pDBE approach identified the Supplemental Approach using all years of data (1977-2021) for Early Stuart as the least biased forecast method and took into account the observed environmental conditions. For Early Summer, Summer and Late run, the retrospective analysis identified that staying with the best performing pre-season forecast method was the best approach (Table F4). Figures F6a, b, c and d provide an overview of the performance of the in-season pDBE approaches for each management group based on the retrospective analysis.

In-season, the Panel was presented with pDBE estimates for each management group (Table F3) based on the best performing pDBE forecast method (Table F4). For Early Stuart sockeye, due to high discharge levels during their upstream migration, the Supplemental Approach predicted a more negative pDBE than adopted pre-season. As a result, the Panel adopted the higher pMA of 13.29 associated with the predicted pDBE of -0.93. During the Early Summer run sockeye migration, discharge levels had dropped, and the river temperature was increasing. The Panel stayed with the pre-season adopted pDBE based on the All-years median pDBE for Early Summer run as recommended by the retrospective analysis. During the Summer run migration Fraser River temperatures at Qualark exceeded the optimum range for aerobic swimming (19.4°C)⁴³ for more than half the migration. A discrepancy between predicted and observed abundance at Big Bar and observations of poor fish condition confirmed that Summer-run sockeye were experiencing upstream migration challenges. While the pre-season 31-day model was the best performing model for Summer run based on the retrospective analysis, it did not take into account the warmer Fraser River temperatures and the upstream migration challenges. Instead the Panel adopted a pMA of 0.19 associated with the predicted pDBE of -0.16 based on the Supplemental Approach with high temperatures. The supplemental approach was the best approach that took into account in-season conditions (Figure F5c). Late-run sockeye also experienced above average temperatures for the time of year, however they did delay their upstream migration for 19 days. The Panel stayed with the pre-season adopted Dominant cycle (2022) median pDBE for Late run which was also the best performing in-season model.

At Big Bar, pre-season there were concerns regarding the high snowpack levels and the potential for high discharge levels hampering migration past Big Bar. In 2019 and 2020, which were both high discharge years, the resulting %DBEs were greater than 99%. The impact of the 2021 Big Bar improvements to natural and assisted passage on high discharge years was still unclear. ([Big Bar landslide response information bulletins | Pacific Region | Fisheries and Oceans Canada \(dfo-mpo.gc.ca\)](#)).

Early Stuart and the early migrating Early Summer run did experience high discharge levels and migration difficulties. However, a large portion of the Early Stuart migration failed to migrate

⁴³ Eliason, E.J., Clark, T.D., Hague, M.J., Hanson, L.M., Gallagher, Z.S., Jeffries, K.M., Gale, M.K., Patterson, D.A., Hinch, S.G. and Farrell, A.P. 2011. Differences in thermal tolerance among sockeye salmon populations. *Science*, 332(6025), 109–112.

through the lower canyon and never made it to Big Bar. The discharge level at the Big Bar slide dropped to below the minimum unimpeded migration threshold of 4300 m³/s on July 9. When sockeye began to arrive at Big Bar, discharge levels had already dropped, and sockeye were able to successfully migrate past the slide.

Table F5 provides a detailed summary of the Management Adjustment approaches by management group.

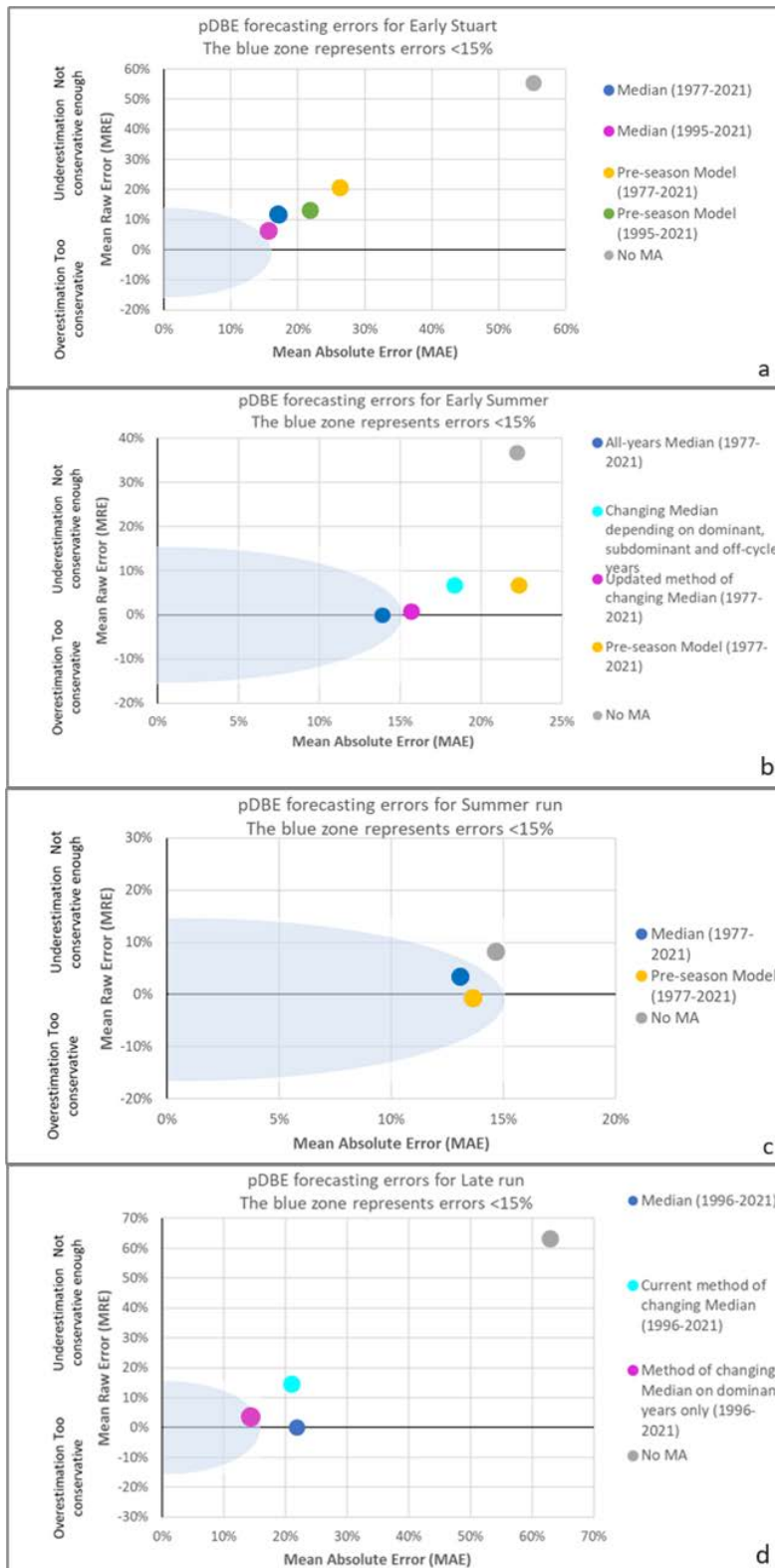


Figure F5. Comparison of performance and forecasting error of different pre-season pDBE approaches using the MRE and MAE performance measures for (a) Early Stuart (b) Early Summer run (c) Summer run (d) Late run. The shaded area in each figure represents an error of 15% or less.

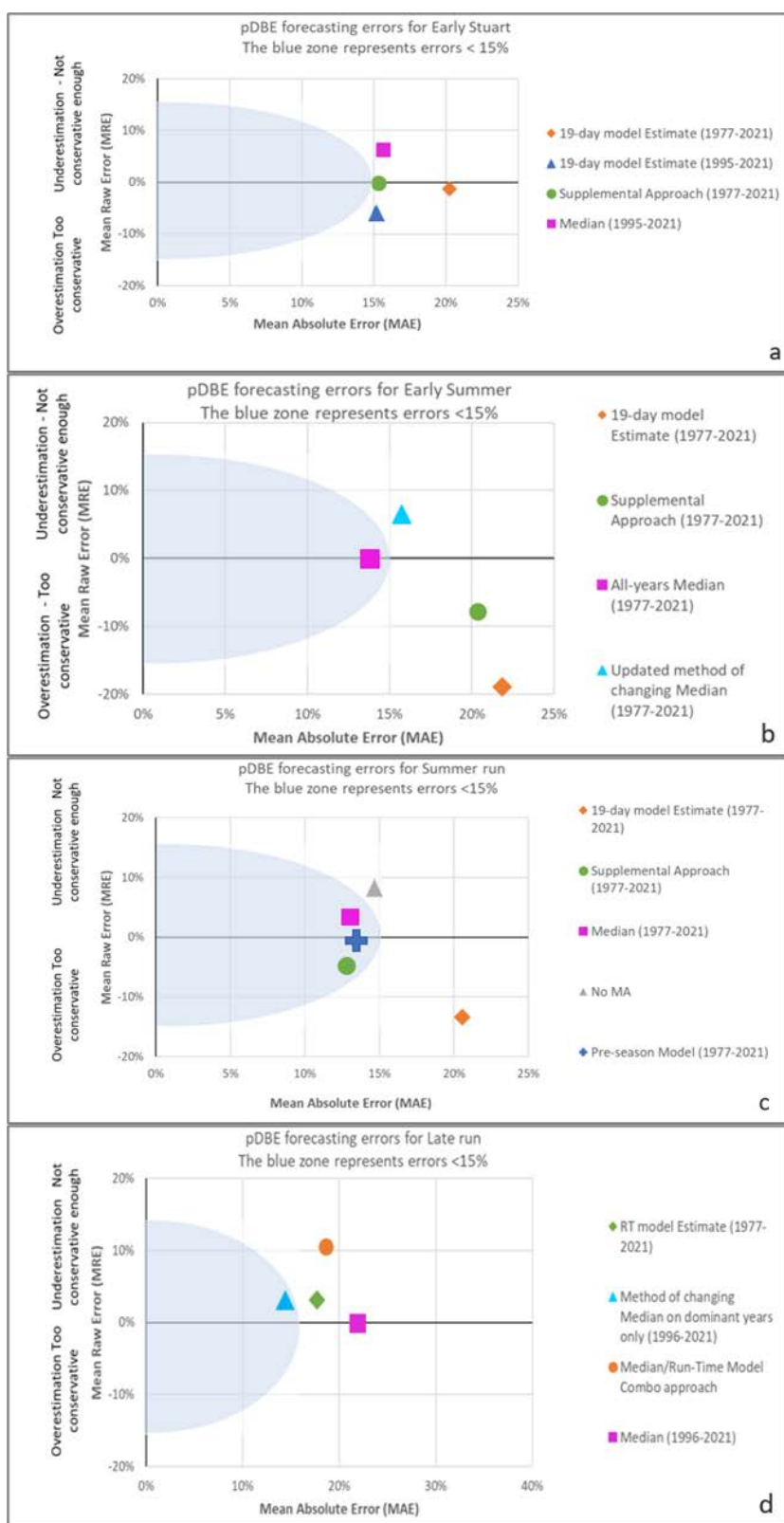


Figure F6. Comparison of performance and forecasting error of different in-season pDBE approaches using the MRE and MAE performance measures for (a) Early Stuart (b) Early Summer run (c) Summer run (d) Late run. The shaded area in each figure represents an error of 15% or less.

Table F 5. Summary of the pre-season and in-season MA models and assumptions used during 2022 management season across management groups.

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

APPENDIX G: HISTORICAL CATCH, ESCAPEMENT AND PRODUCTION DATA

Table G1. Catch by user group, spawning escapement, difference between estimates and run size of Fraser River sockeye salmon for cycle years 2010-2022.

	Fraser Sockeye Salmon			
	2010	2014	2018	2022
CANADIAN CATCH	11,569,200	10,123,400	4,731,500	1,128,900
Commercial Catch	9,243,700	7,989,400	3,188,300	230,100
Panel Area	3,459,100	3,022,200	1,369,700	228,700
Non-Panel Areas	5,784,600	4,967,300	1,818,600	1,400
First Nations Catch	2,015,100	1,776,600	1,398,900	873,400
Marine FSC	308,500	321,100	280,600	331,000
Fraser River FSC	570,100	615,800	607,100	530,400
Economic Opportunity	1,136,500	839,600	511,100	12,000
Non-commercial Catch	310,400	357,400	144,300	25,400
Marine Recreational	80,500	110,300	61,900	880
Fraser Recreational	212,800	242,400	79,800	15,000
Charter	6,600	4,090	2,610	1,190
ESSR	10,500	620	0	0
Other Catch	0	0	0	8,300
UNITED STATES CATCH	1,959,500	887,200	1,047,300	425,300
Washington Total	1,959,500	701,600	993,500	352,300
Commercial catch	1,945,100	698,200	982,800	341,300
Treaty Tribal	1,202,600	470,300	589,600	265,800
All Citizens	742,500	227,900	393,200	75,500
Non-commercial Catch	14,400	3,450	10,700	11,000
Ceremonial	14,400	3,450	10,700	11,000
Recreational	0	0	0	0
Other	0	0	0	0
Alaska	0	185,500	18,700	73,000
TEST FISHING CATCH	71,900	148,700	113,000	41,100
PSC (Panel Areas)	27,000	41,000	71,800	28,100
Canada	17,800	35,100	68,400	28,000
United States	9,200	5,840	3,400	110
Canada (non-Panel Areas)	44,900	107,800	41,200	13,000
TOTAL RUN	28,672,800	20,215,000	10,864,000	7,009,000
Total Catch in All Fisheries	13,600,600	11,159,300	5,891,700	1,595,200
Adult Spawning Escapement	13,130,900	5,877,300	4,100,200	3,511,900
Jack Spawning Escapement	12,100	5,590	2,160	2,820
Difference between estimates	1,929,200	3,172,800	869,900	1,899,100
Percentage of Total Run	100%	100%	100%	100%
Total Catch in All Fisheries	47%	55%	54%	23%
Adult Spawning Escapement	46%	29%	38%	50%
Jack Spawning Escapement	0%	0%	0%	0%
Difference between estimates	7%	16%	8%	27%

Table G2. Escapements of sockeye salmon to Fraser River spawning areas for cycle years 2010-2022*

DISTRICT	Year			
<u>Stock Group</u>				
Stream/Lake	2010	2014	2018	2022
NORTHEAST				
Upper Bowron R.	8,983	12,176	8,406	3,128
STUART				
<u>Early Stuart</u>				
Driftwood R.	25,783	21,774	12,808	1,692
Takla L. Streams	11,061	14,193	10,413	6,891
Middle R. Streams	16,971	24,351	15,308	11,204
Trembleur L. Streams	6,447	8,234	9,960	5,054
Miscellaneous	0	58	0	88
<u>Late Stuart</u>				
Kazchek Cr.	32	9	31	61
Kuzkwa Cr.	3,610	4,325	5,395	4,169
Middle R.	13,340	9,086	17,224	26,960
Tachie R.	57,887	36,036	88,796	55,202
Miscellaneous	372	1,235	743	1,555
NECHAKO				
Nadina R. (Late)	4,783	30,235	148,128	296,737
Nadina Channel	21,359	31,154	29,066	36,691
Stellako R.	202,783	506,157	177,180	125,931
QUESNEL				
Horsefly R.	128,121	463,621	587,012	567,467
Horsefly Channel	22,493	18,078	895	0
McKinley Cr.	1,534	10,266	14,202	33,064
Mitchell R.	75,029	277,953	162,918	169,666
Miscellaneous	21,854	64,458	53,833	57,791
CHILCOTIN				
Chilko R. & L.	2,459,946	1,025,587	618,365	881,253
Chilko Channel	0	0	0	0
Taseko L.	1,117	114	70	1,913
SETON-ANDERSON				
Gates Cr.	6,280	9,679	1,872	2,955
Gates Channel	9,486	6,071	1,605	0
Portage Cr.	57,870	24,275	35,548	18,367
NORTH THOMPSON				
North Thompson R.	8,044	22,741	3,429	5,753
Raft R.	5,119	17,078	3,544	3,865
Fennell Cr.	10,808	11,451	2,430	5,319
SOUTH THOMPSON				
<u>Early Summer-run</u>				
Scotch Cr.	522,367	135,100	82,192	65,257
Seymour R.	552,149	114,002	141,888	30,156
Upper Adams / Momich / Cayenne	3,101	5,810	14,047	756
Miscellaneous	351,176	246,918	269,001	69,026
<u>Late-run</u>				
Adams R.	3,867,225	707,883	536,333	346,686
Little R.	422,358	213,304	127,386	127,898
Lower Shuswap R.	2,897,006	1,027,591	630,844	181,891
Miscellaneous	332,429	259,290	222,739	56,088
HARRISON-LILLOOET				
Birkenhead R.	128,285	35,552	15,056	127,815
Big Silver Cr. & misc. Birk. types	12,578	6,011	1,504	3,143
Harrison R.	761,668	399,531	15,148	31,923
Weaver Cr.	23,833	2,207	1,339	78,149
Weaver Channel	36,064	22,439	13,756	15,397
LOWER FRASER				
Nahatlatch R. & L.	5,413	3,873	2,534	5,031
Cultus L.	10,026	4,603	504	1,231
Upper Pitt R.	16,818	36,496	13,949	29,624
Chilliwack L./Chilliwack R., upper	2,775	3,470	2,341	3,591
MISCELLANEOUS	4,482	2,913	389	7,269
ADULTS	13,130,865	5,877,388	4,100,131	3,503,707
JACKS	12,056	5,588	2,211	2,824
TOTAL NET ESCAPEMENT	13,142,921	5,882,976	4,102,342	3,506,531

* Estimates are from DFO.

¹ Cultus estimates include 357 adults in 2010, 225 adults in 2014, 168 in 2018 and 200 in 2022.

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

Table G3. Detailed calculation of total allowable catch (TAC) and achievement of international catch shares for Fraser sockeye (by management group) salmon in 2022. 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 28), in accordance with Annex IV, Chapter 4 of the Pacific Salmon Treaty.

	Fraser Sockeye				
	Early Stuart	Early Summer	Summer	Late	Total
RUN STATUS, ESCAPEMENT NEEDS & AVAILABLE SURPLUS					
In-season Abundance Estimate	244,000	607,000	3,805,000	2,150,000	6,806,000
Adjusted Spawning Escapement Target *	244,000	597,000	2,264,000	1,347,900	4,452,900
Spawning Escapement Target (SET)	195,200	375,500	1,902,500	1,104,800	3,578,000
%SET from TAM rules	80%	62%	50%	51%	
Management Adjustment (MA)	2,594,200	221,500	361,500	243,100	3,420,300
Proportional MA (pMA)	13.29	0.59	0.19	0.22	
Test Fishing Catch (TF, post-seas. est.)	1,100	6,500	22,500	11,000	41,100
Surplus above Adjusted SET & TF *	0	3,500	1,518,500	791,200	2,313,100
DEDUCTIONS & TAC FOR INTERNATIONAL SHARING					
Aboriginal Fishery Exemption (AFE)	1,700	70,000	175,200	153,100	400,000
Total Deductions (Adj.SET + TF + AFE)	246,800	673,500	2,461,700	1,511,900	4,893,900
Available TAC (Abundance - Deductions)	0	0	1,343,300	638,100	1,981,400
UNITED STATES (Washington) TAC					
Propor. distrib. TAC - Payback	0	0	221,300	105,100	326,500
Proportionally distributed TAC **	0	0	221,600	105,300	326,900
U.S. Payback	0	0	-300	-200	-500
Washington Catch	0	18,900	202,200	131,200	352,300
Other Catch***	0	0	0	0	0
Deviation from TAC - Payback	0	-18,900	19,100	-26,100	-25,800
CANADIAN TAC					
Propor. distrib. TAC + Payback + AFE	1,700	70,000	1,297,200	686,100	2,054,900
Propor. distrib. TAC + U.S. Payback	0	0	1,122,000	533,000	1,654,900
AFE	1,700	70,000	175,200	153,100	400,000
Other Catch***	1,300	2,400	4,200	400	8,300
Canadian Catch excluding ESSR Catch	3,700	58,200	628,900	438,100	1,128,800
Deviation from TAC + Payback + AFE	-3,400	9,400	664,100	247,500	917,800
TOTAL					
Available TAC + U.S. Payback + AFE	1,700	70,000	1,518,800	791,300	2,381,800
Total Catch excluding ESSR Catch	3,700	77,100	831,100	569,300	1,481,200
Deviation from TAC + U.S. Payback + AFE	-2,000	-7,100	687,800	222,000	900,700

* 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



PSC Secretariat report

Review of Fraser River sockeye run size recommendations and fisheries proposals of August 18, 2022, and subsequent consequences

December 20, 2022

During Fraser River Panel regulatory control in 2022, the United States prosecuted a sockeye fishery that Canada objected to under the provisions of Annex IV, Chapter 4, paragraph 13(d)(iii). Pursuant to the same paragraph, the United States provided a rationale for the fishery via correspondence to the Panel's Canadian vice-chair on August 19, 2022 (U.S. rationale, Appendix 1). On October 14, 2022, Canada corresponded with the Executive Secretary (Canadian response, Appendix 2) requesting an objective report on the circumstances of the fishery and its consequences pursuant to Chapter 4, paragraph 13(e). This report responds to that request.

This report addresses four central questions regarding 1) the appropriateness of the run size recommendations, 2) the appropriateness of the U.S. fisheries proposal made on August 18, 3) to what extent the U.S. took into account Canada's concerns, and 4) the consequences for planning subsequent fisheries. It concludes with Secretariat recommendations for improvements going forward.

Executive Summary

Part 1: Background

- In 2022, close to 10 million sockeye salmon were expected to return to the Fraser River based on median preseason forecasts and harvestable surpluses were anticipated. In season, the actual run size (6.8 million) was the smallest on the dominant Shuswap cycle since 1970. Returns for Early Summer and Late run sockeye were much lower than expected, and Late run returns were the lowest on record (since 1952) for this cycle.
- In-season, there was uncertainty regarding the extent to which low returns and early timing of the Early Summer run indicated low returns for Summer and Late run sockeye.
- On August 18, 2022, Canada disagreed with both the run size recommendations for Summer and Late run sockeye put forward by PSC staff and the resulting U.S. fisheries proposals. This led to the correspondence and request for a Secretariat report noted above.
- The median preseason forecasts for Summer and Late run were 4.4 and 3.7 million, respectively. On August 18, PSC staff recommended run size estimates for the Summer and Late run of 4.4 and 2 million, whereas Canada considered 3.8 and 1.6 million more appropriate run size estimates. The United States concurred with the Secretariat's recommendations, meaning the Panel accepted them under Chapter 4, paragraph 13(c).
- As of December 15, 2022, the run size estimates equalled 3.8 and 2.1 million respectively, while the post-season migration timing was 5 days later than the preseason forecast for Summer run and

two days earlier for Late run. Final post-season run size estimates are not yet available as they rely on spawner numbers and run size adjustments.

Part 2: Summary of Secretariat answers to central questions

Were the run size recommendations for Summer and Late run on August 18 in agreement with available information, given low return and early timing of Early Summer run sockeye?

- Abundance of the Early Summer and Summer runs are poorly correlated, so PSC staff did not consider the weak Early Summer run to be a reliable predictor of weakness in the Summer run.
- In-season Summer-run data were available for the August 18 meeting that led the Secretariat to predict the Summer run would be later than forecast.
- Because the peak of the Summer run had not yet been observed in the data, uncertainty associated with the Summer-run run size was substantial and did not preclude reaching the preseason forecast of 4.4 million.
- Despite not having observed the peak of the Late run on August 18, PSC staff recommended a smaller Late-run run size (2 million) given there was in-season information to indicate that the forecast of 3.7 million would not be reached.

Were the U.S. fisheries proposals on August 18 in agreement with available information?

- In its fisheries proposal for August 18, the U.S. took into account the Panel adopted run size estimates of 4.4 million for Summer run and 2 million for Late run as well as the resulting U.S. TAC, the expected incidental harvest for Early Summer run given it was in a Low Abundance Exploitation Rate (LAER) of 20%, and the available U.S. TAC for Late run.
- If Canada's recommended run size estimates of 3.8 million for Summer and 1.6 million for Late run had been adopted, PSC staff would still have evaluated the U.S. fisheries proposal appropriate given the projected harvestable surpluses and predicted U.S. catch.
- When including the U.S. catches that were not reported in-season (33,529 additional sockeye¹), PSC staff would still have evaluated the U.S. fisheries proposal as appropriate, i.e. the available U.S. TAC remained greater than the predicted U.S. fisheries catch even if the run sizes recommended by Canada had been adopted.

Did the U.S. sufficiently consider the concerns raised and suggestions provided by Canada on August 18?

- In comparison to the pre-season plan, the U.S. adjusted its fisheries proposal with in-season information by proposing fisheries openings consistent with the 25th percentile of the run size forecasts (p25) compared to median (p50) returns.
- If the U.S. would have adopted the run sizes recommended by Canada, the proposed U.S. fisheries would still have been endorsed by the Secretariat, given that the predicted U.S. catch did not exceed the available U.S. TAC. even if the unreported catch of 33,529 sockeye had been reported in-season.
- As stated in their rationale, the U.S. considered incidental harvest of Early Summer run sockeye in its fisheries proposal to be small but acceptable given that the resulting exploitation rate of 2.8% was smaller than 16.5% of the Low Abundance Exploitation Rate (LAER) of 20% (3.3%), which is the accepted incidental harvest rate for Early Summer run sockeye according to Canada's Integrated Fisheries Management Plan (IFMP).

¹ The U.S. section provided notice of additional August catch via correspondence to the Secretariat on November 10, 2022.

- Delaying fisheries recommendations by one day until August 19, as Canada suggested, could have had an impact on run size recommendations but not likely to such an extent that evaluation of the U.S. fisheries proposal would have changed.

What were the consequences of the U.S. fisheries of August 19-23?

- Following the August 18 meeting, U.S. fisheries of August 19-23 caught 171,231 Fraser River sockeye, including 73,388 Late run. This resulted in the U.S. exceeding its share of the TAC by 26,360 sockeye or 8.1% (this number includes 33,529 in missing U.S. fish tickets reported post-season). Based on the run size estimates adopted on August 18, and Chapter 4 paragraph 8(c)(iv), there will be no overage pay-back for the U.S.
- It is unlikely the U.S. fisheries significantly affected Canada's ability to achieve its Food/Social/Ceremonial (FSC) catch allocations, given the challenges in achieving this allocation in 2018 when abundances were higher.
- Delayed and reduced Canadian commercial and recreational fishing opportunities resulted from much lower-than-expected run sizes for the Early Summer and Late runs and the in-season uncertainty associated with the Late-run run size estimate. The occurrence of the August 19-23 U.S. fisheries don't appear to be a primary factor
- Even if the August 19-23 U.S. fisheries were not prosecuted, it is unlikely that Canadian commercial and recreational fisheries would have been scheduled before September 6 when the Panel adopted a Late-run run size greater than the p25 forecast. The resulting increase in Canada's TAC due to U.S. fisheries not being prosecuted would mainly have impacted Area B and H fisheries, that would have had their combined ITQ increase by 40,000 sockeye.
- The Panel authorized no pay fish retention in 2022 test fisheries. In accordance with the PSC Test Fishing Policy, it is unlikely that pay fish would have been taken in 2022 even if the August 19-23 U.S. fisheries had not occurred. This is due to the lack of harvestable surpluses for Early Summer run stocks, the limited and uncertain harvestable surplus for Late run stocks, and Canadian priorities to meet FSC and First Nation (FN) domestic allocation objectives.

Background

The median pre-season forecast for 2022 totaled 9.8 million sockeye. Assuming pre-season run size expectations would be met, Canada expected to catch almost 2.2 million sockeye while the U.S. expected 550,000 sockeye in catch based on pre-season fishing plans. In-season, the total run size equalled 6.8 million sockeye, which was the lowest run size on this cycle since 1970. This was because returns for Early Summer and Late run were much smaller than expected. Late run returns were the lowest on record (since 1952) on this cycle. Pre-season and in-season, there was substantial uncertainty regarding the extent that low returns and early timing for Early Summer run would indicate low returns for Summer and Late run.

On August 18, 2022, Canada disagreed with both the run size recommendations for Summer and Late run Fraser River sockeye put forward by PSC staff and the fisheries proposed by the U.S. following adoption of those run sizes. Despite these disagreements and following Treaty language, the Fraser River Panel adopted the run size recommendations and the U.S. prosecuted its fisheries. According to the Treaty, run size adoption only requires one National Section of the Panel to agree with the recommendation put forth by the PSC staff. PSC staff considered the proposed U.S. fisheries to be consistent with the adopted run sizes. Due to the disagreement between the parties, the Treaty (Chapter 4, paragraph 13diii) stipulates that the National section prosecuting the fishery, in this case the U.S., must provide a written rationale for the proposed fishery. This United States provided this rationale on August 19, 2022 (Appendix 1). Canada relayed its concerns about the run sizes and fisheries recommendations on October 14, 2022 (Appendix 2), pursuant to Chapter 4, paragraph 13(e). This required PSC staff to provide an objective report on the circumstances surrounding the resulting fishery openings and their consequences.

Pursuant to Chapter 4, paragraph 13(e), the current report is provided for the January Post-Season meeting. Based on this report, the Panel shall determine what action is required and, if there is no mutual decision on the appropriate action, the Commission will address this issue at the February 2023 annual meeting.

Method used to evaluate concerns raised by Canada

This report provides a detailed review of Canada's concerns over run size recommendations and proposed fisheries, as well as the consequences of these assessments and associated management decisions. In addition to available data and analyses, the Secretariat examined the assertions in the U.S. rationale and the Canadian response.

The Secretariat has distilled Canada's concerns into a set of principal and secondary questions to be answered in this report:

1. Were the run size recommendations for Summer and Late run on August 18 in agreement with available information, given the low returns and early timing of Early Summer run sockeye?
 - a. To what extent can estimates of poor returns of earlier timed stocks, such as Early Thompson, provide information about run size estimates of Summer and Late run stocks?
 - b. Was it appropriate to assume the timing for Summer run stocks would be later than forecast given that Early Summer run stocks returned earlier than forecast?
 - c. Did PSC staff appropriately consider the in-season information and the associated uncertainty when making a run size recommendation for Summer run?
 - d. For Late run, were results from different run size models used appropriately for recommendations?
2. Was the U.S. fisheries proposal on August 18 consistent with the available information?
 - a. Was the U.S. fisheries proposal appropriate given the recommended run sizes?

- b. To what extent did the U.S. fisheries proposal consider the impact on Early Summer and Late run sockeye?
 - c. Would the U.S. fisheries proposal have been appropriate if the Panel had adopted the run sizes for Summer and Late run Canada proposed?
 - d. If the missing U.S. fish tickets reported post-season would have been available in-season, to what extent would it have impacted the fisheries proposal and evaluation?
3. Did the U.S. sufficiently consider the concerns raised and suggestions provided by Canada on August 18?
 - a. Did the U.S. adjust its fisheries proposal in response to in-season information and Canada's concerns (in comparison to the pre-season plan and to Canada's proposed options for significantly reduced U.S. fisheries)?
 - b. If the U.S. would have adopted the alternative run size recommendations by Canada, how would the U.S. fisheries proposal have been affected?
 - c. How would run size estimates and fisheries recommendations have differed if they had been delayed until Friday, August 19 as recommended by Canada?
4. What were the consequences of the U.S. fisheries of August 19-23?
 - a. To what extent did the U.S. exceed its share of the TAC for 2022?
 - b. If the U.S. would have adopted the alternative run size recommendations by Canada on August 18, how would this have affected the U.S.?
 - c. To what extent did the run size and fisheries recommendations on August 18 impact Canadian fisheries?
 - d. Were run size and fisheries recommendations on August 18 responsible for the lack of pay fish retention in 2022?

Each principal question is followed by a list of concerns noted in the Canadian response. The secondary questions are meant to answer different aspects of the principal question in detail. For each principal question, the Secretariat offers a conclusion based on staff analyses. At the end of the report, the Secretariat provides a list of recommendations.

Review

1. **Were the run size recommendations for Summer and Late run on August 18 in agreement with the available information, given the low return and early timing of Early Summer run sockeye?**

Concerns from Canada (Canadian response, Appendix 2.A):

- *Run size recommendations for Summer run and Late run were overly optimistic given the poor performance of South Thompson Early Summer run returns and the earlier timing pattern exhibited for the entire Early Summer run timing group.*
- *PSC Secretariat staff focused on a regression analysis of timing information for Early Stuart and Lake Washington sockeye ... which suggested a return timing 3 days later than the pre-season panel agreed timing.*
- *PSC staff assumed a run timing for Chilko/Quesnel component of the Summer run return to be 5 days later than the pre-season adopted run timing and 2 days later than their regression analysis which Canada did not feel the in-season data supported.*
- *Using the [uncertain test fishing] information to justify recommending the most optimistic run size for Summer run was not conservative in Canada's view and does not take into account the uncertainty in the information.*
- *PSC staff provided six different assessments to inform Late Shuswap/Portage sensitivity analysis. ... The PSC recommended the most optimistic run size of 2 million which Canada did not support based on the information presented in the package.*

1a. To what extent can estimates of poor returns of earlier timed stocks, such as Early Thompson, provide information about run size estimates of Summer and Late run stocks?

When evaluated statistically, signs of good or poor returns in other areas (e.g. non-Fraser stocks) or for earlier timed Fraser sockeye stocks are generally poor indicators of good or poor returns of later timed Fraser sockeye stocks. Figure 1 illustrates the poor correlation between run size estimates of Early Summer run stocks with Summer and Late run stocks using cycle line years. Overall, these figures show that predicting the returns of Summer and Late run stocks based on Early Thompson returns is statistically not supported.

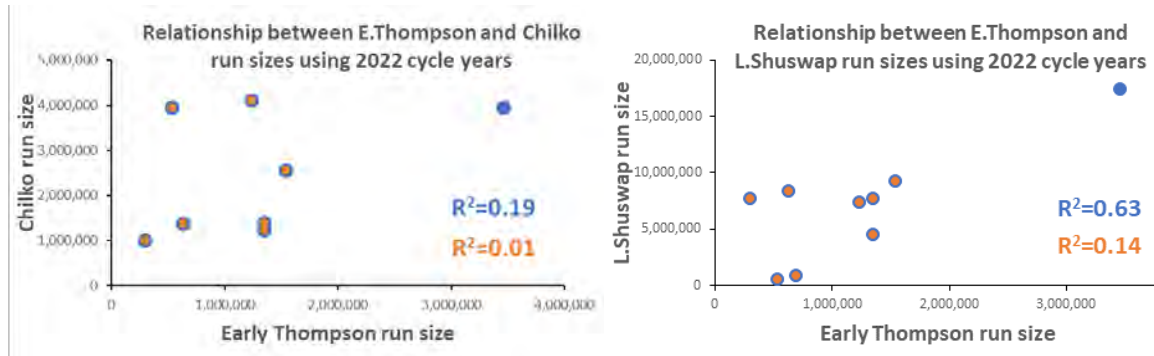


Figure 1: Correlation between Early Thompson (normally the most abundant Early Summer run stock on the 2022 cycle) and later timed Fraser River sockeye stocks: Chilko represents Summer run and Late Shuswap represents Late run stocks. In addition to the R^2 when using all available cycle line data (blue), an additional R^2 has been provided that excludes the very large returns of 2010 (orange).

Over the years, correlations of returns between Fraser sockeye stocks, Fraser sockeye management groups, and non-Fraser sockeye stocks have been tested in various formats (in terms of run size, forecast bias and productivity). Thus far, the best-performing model that takes into account abundances and survival rates of early timed stocks to predict the abundance of later timed stocks is the Smolt Method of Updating Run Forecasts (SMURFing, Latham and Michielsens 2022). This method relies on in-season run size estimates for Early Thompson to predict abundances for Late Shuswap/Portage by relying on these stocks' relative abundance during juvenile outmigration and assuming equal post-smolt marine survival. SMURFing worked well to provide an early indication of Late-run run size in 2014 and 2018 when suitable smolt data were available. It has not been possible to apply this method in more years given limited or non-existent smolt data. The smolt information from 2020 was of a much lower quality compared to the previous years because the sampling programs of out-migrating smolts were impacted by COVID. This resulted in a sample size of 325 smolts that was used for the SMURFing analysis in 2022, which was approximately one tenth of the number of samples available in 2014 and 2018. The application of this method on August 18 resulted in a predicted median run size for Late run of 1.2 million. The low smolt sample size, combined with the fact that this method had only been successfully used in two previous years, resulted in PSC staff being reluctant on August 18 to recommend a run size for Late run based on this method. Staff did however recommend a Late-run run size (2 million) that was substantially lower than the preseason forecast of 3.7 million.

Conclusion

- Given the poor correlation between run size estimates for Early Summer and Summer run stocks, PSC staff considered run size estimates for the Summer run independent of Early Summer run returns.

- Given the very limited smolt information from 2020 and the limited track record of the model, PSC staff considered the Late run estimate based on the in-season run size for Early Thompson in combination with the smolt information as an early indicator of Late run abundance instead of using it for run size recommendations.

1b. Was it appropriate to assume the timing for Summer run stocks would be later than forecast given that Early Summer run stocks returned earlier than forecast?

Unlike run size estimates, there is substantial correlation between the timings of some early Fraser sockeye stocks and some later stocks. The timing correlation is used routinely in-season to provide early updates for the forecasted timing of later groups. However, only when the predictions based on timing correlations differ substantially from the preseason timing forecasts are timing estimates updated. On August 4, the Technical Committee reviewed and supported the timing correlation analysis that indicated the timing for Chilko could be 3 days later than the preseason forecast, based on the observed timings of earlier stocks. The statistical model selection process indicated that a combination of data from Early Stuart and Lake Washington was more informative for predicting Chilko than data from Early Summer stocks. Results for Quesnel similarly indicated later timing while timing correlations for other stocks, including Early Thompson predicted timing estimates similar to their forecasts.

Updated timing forecasts based on historical correlations are revised once in-season observations are available as in-season data provide a more accurate assessment. On Aug 18, there was additional in-season information to indicate that the timing of Summer run stocks would be later than predicted preseason (Figure 2). The in-season time-density model for Chilko/Quesnel/Raft/N. Thompson (the dominant component of the Summer run) generated a median estimate of August 17, 6 days later than the preseason forecast. Although the model timing estimate was uncertain (ranging from August 14-19), the in-season data was still informative enough to generate a timing estimate 4-days later than the prior assumption of August 13 based on the timing correlation model, and with much greater certainty. If the in-season data had been uninformative, the posterior probability distribution for timing would have equaled the prior probability distribution.

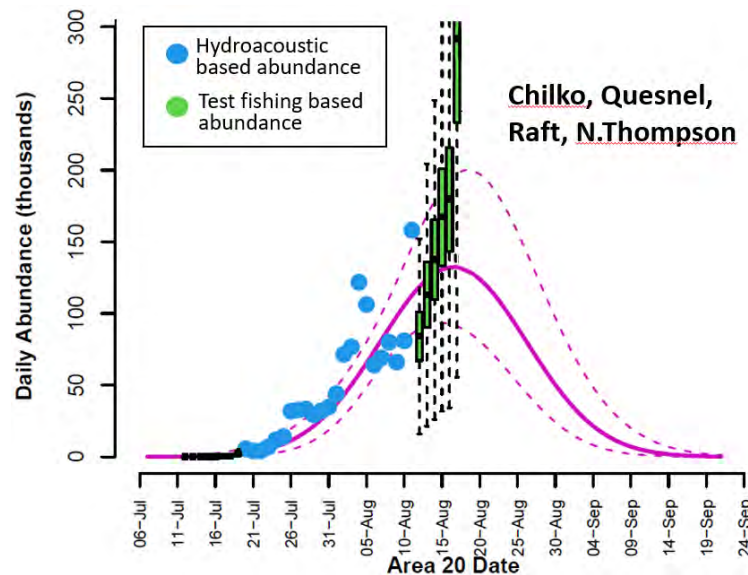


Figure 2: Illustration of the abundance estimates based on hydroacoustic and test fishing data and the fit of the time-density model on August 18 for Chilko, Quesnel, Raft, North Thompson (Summer run). The test

fishing-based estimates are more uncertain due to the uncertainty associated with the expansion line (1/catchability), and the resulting abundance estimates have been represented using boxplots. Note that only matching Area 12 and 20 test fishing data are shown, meaning the final day of test fishing data from Area 12 is not presented here because of the lack of matching Area 20 data.

Conclusion

- On August 18, there was sufficient in-season information available for Summer run sockeye to indicate the timing would be later than forecast.

1c. Did PSC staff appropriately consider the in-season information and the associated uncertainty when making a run size recommendation for Summer run?

For Summer run sockeye, in-season run size estimates rely on a Bayesian time-density model that fits a normal distribution to the available data (Michielsens and Cave 2019). The main challenge with in-season assessments such as these is the simultaneous estimate of timing and total run size, as the peak of the run can only be confirmed once more than 50% of the migration has passed. Consequently, prior to the peak, run sizes that are small and early, or late and large, may be indistinguishable (Adkison and Cunningham 2015). While it is possible to run the time-density model even when data indicate the peak of the run has not yet been observed, the results will depend on the assumed prior probability distribution for timing; if the timing in the prior is assumed to be early, the run size will be smaller than if the prior assumes a later timing. As mentioned in the previous section, on August 18, there was a strong indication that the timing was likely later than the preseason forecast, but there was no indication that the peak of the Summer run had been observed when evaluating the combined purse seine test fishing CPUE time series (Figure 3, left panel).

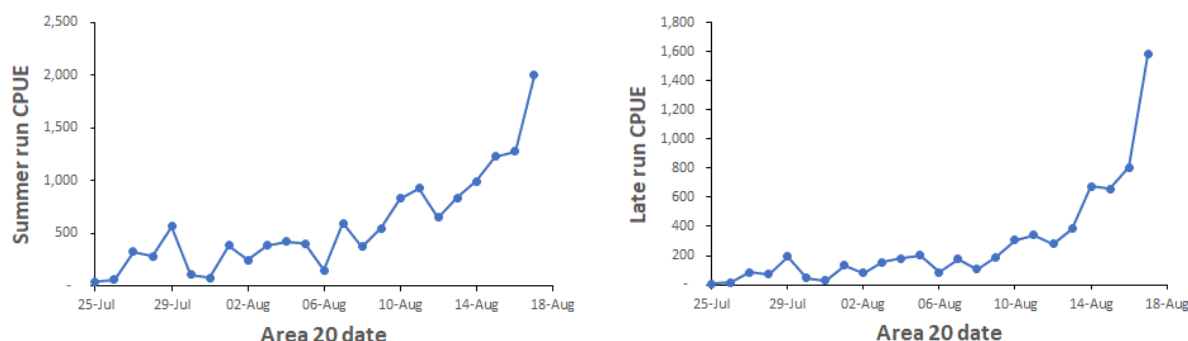


Figure 3: Purse seine test fishing CPUE time series for Summer and Late run sockeye available on August 18. These data rely on CPUE estimates from both the Area 12 and 20 ($CPUE_{Tot} = CPUE_{A12} + 2.2 * CPUE_{A20}$, Michielsens and Martens 2022), whereby the data from Area 12 is offset by one day to account for the longer migration time from the Area 12 to Mission in comparison to the Area 20. The Area 12 data for August 17 has therefore not been included in this graph, as matching Area 20 data were not yet available for August 18. On August 17, the Area 12 CPUE data for Summer and Late run were respectively 6% and 28% smaller than on the previous day.

The median run size estimate for Summer run on August 18 was close to 3.8 million: about 1.5 million of the run had been accounted for in catch plus escapement and 2.3 million were estimated to be en-route to Mission based on the results of the Bayesian time-density model. Due to the uncertainty associated with the test fishing data, this run size estimate used the last 6 days of test fishing data to fit the time-density model (Figure 2) but did not rely on the associated reconstructed abundance estimates when deriving the total run size. Using the test fishing data for those 6-days would have resulted in a Summer-run run size estimate of 4.3 million. Given the uncertainty in the test fishing estimates and given that more than 50% of the Summer run had not yet been observed in the river,

there was considerable uncertainty associated with the Summer run estimate on August 18, which was reflected in the 80% probability interval which ranged from 2 million to 5.4 million. As such, the in-season information was not inconsistent with the preseason forecast of 4.4 million, particularly since the peak of the run had not yet been observed. In retrospect, it may have been more transparent for PSC staff not to have made a run size recommendation of 4.4 million for Summer run on August 18, given the uncertainty around the timing and run size estimates and the lack of a clear signal that the in-season information was inconsistent with the median preseason forecast. This would not have changed the available harvestable surplus but would have put more of the onus on both countries to be cautious in terms of fisheries planning given the uncertainty and the lack of an in-season run size update.

Conclusion

- On August 18, the peak of the Summer run had not yet been observed in the data, and there was insufficient in-season data to provide evidence that the Summer-run run size was substantially different from the initial forecast. Therefore, PSC staff recommended adopting the preseason median forecast of 4.4 million.
- Given the considerable uncertainty associated with the run size on August 18, it may have been better if no recommendation had been made, but the outcome would still have left the run size at the forecast 4.4 million.

1d. For Late run, were results from different run size models used appropriately for recommendations?

On August 18 there was no indication that the peak of the Late run had been observed (Figure 3, right panel), and therefore it was difficult to estimate the Late-run run size using the traditional time-density model at that time. In-season assessments of Late run are also more complicated than for Summer run because part of the run delays its upstream migration into the Fraser River which makes it difficult to confirm test fishing-based marine abundance estimates once salmon migrate into the Fraser River. This results in greater run size uncertainty for Late run stocks compared to other management groups.

Over the years, PSC staff have developed a series of alternative methods of lesser quality than the run timing model that can provide early indications of the Late-run run size prior to observing the peak of the Late run or estimating the abundance of the delaying component of the Late run through Gulf Troll surveys. On Aug 18, the results of all available methods were presented to Fraser Panel and Technical Committee in a figure (Appendix 2.C) to highlight that, even though it was too early to provide a Late-run run size estimate given the traditional time-density model or based on Gulf Troll data, there was already sufficient in-season information available to indicate it would be unlikely that the preseason forecast of 3.7 million would be reached. The results of the various methods were not, however, intended to derive a run size recommendation given expected shortcomings in data quality they relied upon or the potential risk to underestimate the run size. Some concerns PSC staff had with individual estimates are highlighted below. On August 18, using the traditional time-density model for estimating the abundance of the Late Shuswap-Portage stock group resulted in a total Late-run run size estimate of 1.2 million, with an 80% probability interval ranging from 700,000 – 2.6 million. Retrospective analyses done previously (Michielsens and Cave 2019) indicated that the time-density model tends to underestimate run size when applied near the peak of the run (Aug 18 was the pre-season forecasted timing for this group) and fit only to test fishing data. The risk of underestimating the run size was also reflected in the model outputs (Figure 4), which indicated the model ignored the increasing trend in abundance in recent days due to the larger uncertainty associated with test fishing data. The timing estimated by the model was also one of the earliest Late run timings on record. Based on the

retrospective analysis, additional days of data would be required to confirm the peak of the Late run and prevent the model from underestimating the run size (Michielsens and Cave 2019).

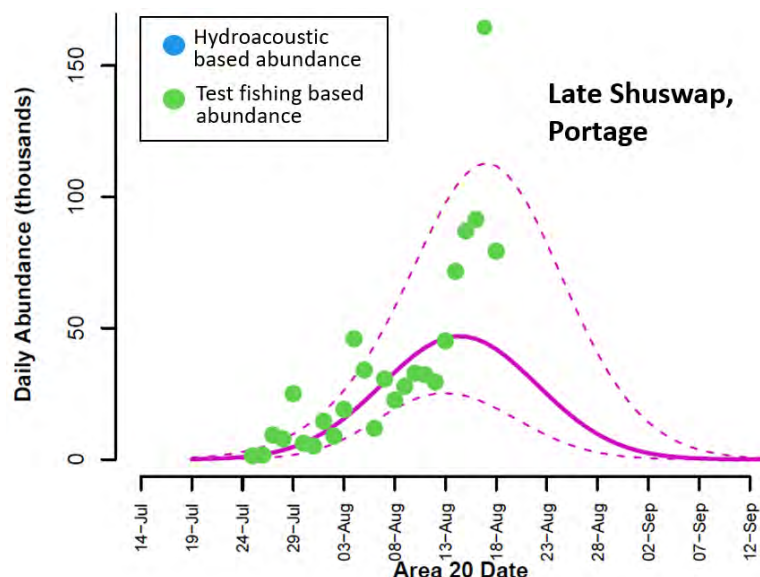


Figure 4: Fit of the time-density model to the Late-run CPUE data. Even though only the median estimates are displayed here, the model takes into account the uncertainty associated with the expansion lines (1/catchability) applied to the CPUE data. The larger uncertainty associated with test fishing data results in the model ignoring the increasing trend in abundance in recent days, thereby underestimating the run size prior to observing the peak of the run, as has been illustrated retrospectively (Michielsens and Cave 2019).

In 2014 and 2018, smolt data in combination with in-season run size estimates for Early Thompson had been relied upon to obtain an early indication of the Late-run run size through SMURFing. When applied in 2022, the resulting run size for the entire Late run group was 1.2 million (900,000 to 1.7 million 80% probability interval). While similar to the run size estimates using the time-density model, PSC staff had concerns about the quality of the smolt data (one tenth of the sample size compared to the previous two years) and the fact that the model had only been tested in two previous years.

One of the run size assessment methods presented on August 18 for which there were no particular concerns about the data quality or known biases was the method that relied on the assumed timing for Late run to predict the run size estimate. As mentioned previously, PSC staff routinely run multiple regression analysis using the in-season timing estimates of earlier timed groups to predict the timing for later timed groups (Figure 5). When evaluated retrospectively, the best performing model to predict Late Shuswap-Portage timing was an analysis that relies on in-season timing estimate of Early Stuart and Early Thompson. The resulting timing was August 18, with the 80% probability interval ranging from August 15 to August 21. On August 18, because the peak of the Late run was not yet discernable in CPUE data, a peak migration timing of August 18 seemed much more reasonable compared to assuming a peak migration timing of August 14, as estimated by the time-density model and as implied by the run size estimate derived by SMURFing. Given the greater credibility of the assumed timing of this model in comparison to other models, the run size implied by an August 18 timing was used as the basis of the 2,000,000 Late-run run size recommendation.

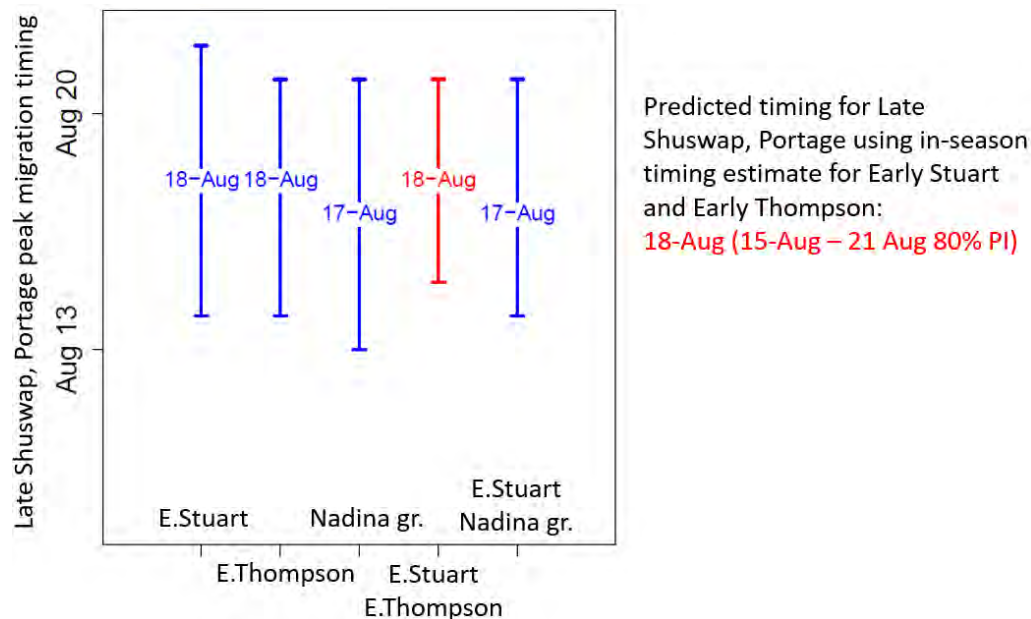


Figure 5: August 17 prediction of timing for Late Shuswap-Portage based on a multiple regression analysis using in-season timing estimates for E.Stuart, E.Thompson, Nadina, Bowron, Gates, Nahatlatch and Taseko (“Nadina group”), Early Stuart and Early Thompson combined and Early Stuart in combination with the Nadina group. Retrospectively, the best performing model was the model that relied on in-season timing estimates for Early Stuart and Early Thompson, which resulted in a timing estimate for Late Shuswap-Portage of August 18 (August 15-21 80% probability interval). This in-season timing estimate for this group equaled the preseason timing forecast.

Typically, PSC Staff do not make recommended updates to run sizes until there is sufficient in-season information to provide an unbiased estimate from the time-density model. However, given the multiple early signals indicating that the Late-run run size was likely significantly lower than the preseason forecast, it was prudent for staff to communicate these signals, even when the absolute run size estimate was still uncertain. PSC staff recommended an estimate based on the timing model as it was the one model without known bias which had been routinely used as an early indication of run size when the daily abundances are much lower than expected. It was appropriate for PSC staff to recommend a Late-run run size estimate based on one of the models as opposed to model averaging given the known biases and data quality issues for some of the models.

Still, PSC staff should do a better job at communicating these differences to the Panel and Technical Committee. There would have been more opportunity to discuss alternative approaches and related concerns at a Technical Committee meeting in isolation from the Panel, but the Parties agreed to expedite business and convene the Technical Committee and Panel jointly on August 18. This approach meant less time was allocated to discussing some of these important technicalities in more detail. Assuming the Panel would have instead met as regularly scheduled on Friday, the Technical Committee and staff could have better scrutinized the models and rationale regarding the model selection prior to the Panel meeting.

Conclusion

- PSC staff did not recommend Late-run run size based on the results of the time-density model or the SMURFing model. The time-density model in general underestimates the run size for Late run when used at the peak of the run and, on August 18, the model fit ignored the increasing trend in CPUE data. Concerns raised for SMURFing included its short track record, the low

sample size and quality of the smolt data from 2020, and the fact that the timing implied by the run size was not in line with in-season CPUE observations.

- PSC staff recommended a Late-run run size based on the predicted Late-run run timing given the greater credibility of this model: no known biases, consistent with in-season trends in Late run CPUE data, and in line with in-season timing information for Early Thompson.
- PSC staff should account for differences in model performance and data quality instead of model averaging, but PSC staff should do a better job of communicating these differences.

2. Was the U.S. fisheries proposal on August 18 consistent with the available information?

Concerns from Canada (Canadian response, Appendix 2.A):

- *Fishing decisions adopted by the U.S. were not consistent with the information available at the time.*
- *The decisions taken by the U.S. section of the Fraser Panel on August 18 placed more emphasis on [meeting Treaty defined international allocations] and [achieving domestic objectives] than [obtaining spawning escapement goals by stock or stock group].*

2a. Was the U.S. fisheries proposal appropriate given the recommended run sizes?

Under Chapter 4 provisions, the Secretariat evaluates national fisheries proposals using projected harvestable surpluses. Because U.S. fisheries that concentrate on the most abundant management group may result in harvest of more than the allocated 16.5% of the TAC for one or more of the less abundant management groups, the incidental harvest should also meet the Chapter 4 criterion of being “small but acceptable”. According to the Panel’s agreed Roles and Responsibilities document (June 23, 2022), both parties evaluate if the catch implied by U.S. fisheries proposals is small but acceptable. Secretariat staff are not involved in the evaluation of what constitutes a small but acceptable catch.

The run size estimates adopted by the Panel on August 18 resulted in a projected U.S. harvestable surplus (available U.S. TAC) on that date of 235,950 sockeye (Table 1). Based on the August 18 U.S. fisheries proposal, PSC staff predicted that the U.S. catch would be 102,400 sockeye. Catch estimates were presented for a variety of methods including historical CPUE data, planning model simulations, and current observations and projected abundances. Predictive evaluations of fisheries harvest are notoriously uncertain due to assumptions made about the abundance of salmon exposed to the fishery, the expected catchability, and the true fishing effort employed. But even the catch projections that rely on historical daily harvest rates per vessel that were higher than early-season harvest rate estimates indicated that the available U.S. TAC on August 18 was sufficient to approve the proposed U.S. fisheries.

Table 1. Overview of the information available on August 18, 2022, to evaluate if the U.S. fisheries proposed for August 19-23 were appropriate given the PSC recommended run size estimates for Summer and Late run. In addition to the run sizes, the information included the available U.S. TAC at the time of the meeting, the predicted U.S. catch associated with the fisheries proposal, and the predicted U.S. catch balance after execution of the fishery.

	E. Stuart	E. Summer	Summer	Late run	Total
PSC recommended run sizes	244,000	627,000	4,403,000	2,000,000	7,274,000
Available U.S. TAC on Aug 18*	0	-13,660	219,450	30,160	235,950
Predicted catch for Aug 19-23 by U.S. fisheries	0	3,600	69,300	29,500	102,400

Remaining U.S. catch balance	0	-17,260	150,150	660	133,550
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*Available U.S. TAC based on in-season information and not accounting for U.S. catch reported post-season.

Conclusion

- Based on projected harvestable surpluses and predicted U.S. catch by PSC staff, the U.S. fisheries proposal was appropriate given the recommended run sizes.

2b. To what extent did the U.S. fisheries proposal have an impact on Early Summer and Late run sockeye?

Under Chapter 4, fisheries proposals may result in incidental harvest of one or more management groups for which the U.S. share of 16.5% of the TAC will be exceeded, provided the incidental harvest of these catches is considered “small but acceptable”. On August 18, there was no U.S. TAC remaining for Early Summer run, requiring both Canada and the U.S. to consider if the catch of Early Summer run sockeye in excess of the U.S. TAC should be considered small but acceptable incidental harvest. The Treaty language does not clarify what constitutes a small but acceptable catch. According to the Roles and Responsibilities document (June 23, 2022), both parties evaluate if the catch implied by U.S. fisheries proposals is small but acceptable. Secretariat staff are not involved in this evaluation.

It is unclear what criteria Canada used to evaluate small but acceptable incidental harvest, and to what extent it is used consistently when evaluating fisheries. For example, at the August 16 Fraser River Panel meeting there was no available International TAC for Early Summer run (Table 2), but the U.S. had a catch-to-date of 13,740 Early Summer run sockeye. At the time of the August 16 meeting, U.S. fisheries were proposed that would see the Early Summer run catch increase by 1,600 to 15,340 sockeye, which corresponded to a total incidental U.S. harvest of 2.5%. Canada stated during this meeting that it did not consider these U.S. catches of Early Summer run sockeye small but acceptable but still approved the proposed U.S. fisheries. On August 18, the proposed U.S. fisheries were expected to increase the total incidental U.S. harvest to 2.6%.

Table 2. Overview of fisheries management information available on August 16 and August 18 that could potentially be used to evaluate small but acceptable incidental harvest for Early Summer run. The Treaty provides no quantitative definition of small but acceptable incidental harvest. The criteria used by Canada to evaluate the catch of U.S. fisheries small but acceptable are unclear, but they resulted in Canada approving the U.S. fisheries proposal on August 16. The U.S. assumes the same U.S. share of the LAER as the international TAC (16.5%) when evaluating small but acceptable incidental harvest, with the understanding that the U.S. share of the LAER is not a target.

Early Summer run	Aug 16 meeting	Aug 18 meeting
Adopted run size	614,000	627,000
Total U.S. TAC	0	0
Available U.S. TAC at the time of the meeting	-13,740	-13,660
Predicted Early Summer catch by proposed U.S fisheries	1,600	2,400
Available U.S. TAC after incl. predicted catch	-15,340	-16,060
Early Summer run LAER	20%	20%
U.S. LAER, assuming proportional sharing (16.5%)	3.3%	3.3%
Total incidental U.S. harvest based on U.S. fisheries proposal	2.5%	2.6%
Canada approved proposed U.S. fisheries?	Yes	No

The U.S. presented their evaluation of the small but acceptable criteria in relation to the Low Abundance Exploitation Rate (LAER, see U.S. fishery rationale, Appendix 1). According to Canada’s

Integrated Fisheries Management Plan (DFO, 2022), LAERs allow for incidental harvest on co-migrating stocks for which there is no available TAC. Canada has been clear that the LAER is not a target and is meant to provide room for incidental harvest on co-migrating stocks and species. In 2022, the LAER for Early Summer run was 20%. According to the U.S., a reasonable assumption would be to distribute the LAER between the parties using the same 16.5% assumed for the U.S. share of the International TAC. This would translate into a U.S. LAER of 3.3%. On August 18, the proposed U.S. fisheries would bring the U.S. incidental harvest of Early Summer run sockeye to 2.8%, which is less than 3.3% and was therefore small but acceptable based on the U.S. interpretation.

For Late run, which was not in a LAER, the predicted catch of the proposed U.S. fisheries did not exceed the available U.S. TAC.

Conclusion:

- The U.S. took into account the impact of its fishery proposal on Early Summer and Late run sockeye.
- There is no quantitative definition of small but acceptable provided in the Treaty language.
- The U.S. considered the incidental harvest of Early Summer run sockeye in its fisheries proposal to be small but acceptable, given that the resulting exploitation rate of 2.8% was smaller than 16.5% of the Low Abundance Exploitation Rate (LAER) of 20%, which is the accepted incidental harvest rate for Early Summer run sockeye according to Canada's Integrated Fisheries Management Plan.
- For Late run, the predicted catch of the U.S. fisheries proposal did not exceed the available U.S. TAC based on the PSC recommended run size for Late run.

2c. Would the U.S. fisheries proposal have been appropriate if the Panel had adopted the run sizes for Summer and Late run Canada proposed?

At the meeting on August 18, Canada disagreed with the run size recommendations provided by PSC staff and recommended alternative run size estimates based on the information provided to the Panel. Canada recommended a run size of 3,762,000 for Summer-run sockeye and 1,604,000 for Late-run sockeye. If these run size estimates were adopted, the projected available U.S. TAC on that date would have been 119,850 sockeye (Table 3). Based on a predicted U.S. catch of 102,400 sockeye, the available U.S. TAC on August 18 was sufficient to approve the proposed U.S. fisheries.

Table 3. Overview of the information available on August 18, 2022, to evaluate if the U.S. fisheries proposal that day was appropriate had Canada's recommended run size estimates for Summer and Late run been adopted. In addition to the run size, the information included the available U.S. TAC at the time of the meeting, the predicted U.S. catch associated with the fisheries proposal, and the prediction of the U.S. catch balance after execution of the fishery.

	E. Stuart	E. Summer	Summer	Late run	Total
Canadian recommended run sizes	244,000	627,000	3,762,000	1,604,000	6,237,000
Available U.S. TAC on Aug 18*	0	-13,660	168,620	-35,110	119,850
Predicted catch for Aug 19-23 by U.S. fisheries	0	3,600	69,300	29,500	102,400
Remaining U.S. catch balance	0	-17,260	99,320	-64,610	17,450

* Available U.S. TAC based on in-season information and not accounting for U.S. catch reported post-season

If the Late-run run size of 1.6 million proposed by Canada had been adopted, the Late run would have been managed under a LAER and there would have been no available U.S. TAC remaining, even prior to considering the additional U.S. fisheries. Including the predicted catch associated with the proposed U.S. fisheries of August 19-23 would have resulted in a negative Late-run balance of 64,610 sockeye (Table 3). This excess catch would be equivalent to 4% of the recommended run size. Assuming the U.S. applied the same criteria to evaluate small but acceptable harvest for Late run as they had for Early Summer run, this incidental harvest of Late run would not have been considered small but acceptable.

Conclusion

- Assuming Canada’s recommended run size estimates for Summer and Late run had been adopted, PSC staff would still have evaluated the U.S. fisheries proposal appropriate, given the U.S. total catch was still projected to be within the total TAC available to them. Overages at the management group level are not considered by PSC staff when considering fisheries recommendations.
- Assuming Canada’s recommended run size estimates for Summer and Late run had been adopted, the incidental harvest of Late run sockeye in excess of the TAC would no longer be considered “small but acceptable”, according to the same criteria applied by the U.S. when evaluating their Early Summer-run catches.

2d. If the missing U.S. fish tickets reported post-season would have been available in-season, to what extent would it have impacted the fisheries proposal and evaluation?

On November 10, 2022, the U.S. alerted PSC staff to the fact that one of their fish buyers had not provided their landing estimates in a timely manner. A total of 33,529 sockeye had not been reported in-season and, as a result, the U.S. Treaty Tribal fisheries catch (Commercial and Ceremonial & Subsistence) increased from 243,233 sockeye to 276,762. The U.S. indicated that they had taken domestic action to correct this oversight and ensured this would not happen in the future.

Of the 33,529 sockeye reported post-season, 13,043 sockeye were caught before August 18. Including these missing U.S. catches in the evaluation of harvestable surplus on August 18, the available U.S. TAC at adopted run sizes (222,907 sockeye) remained larger than the predicted U.S. catch (102,400 sockeye, Table 4). Even if the lower run sizes recommended by Canada were adopted, the available U.S. TAC would remain higher than the predicted catch.

Table 4. Comparison of the catch predicted for the U.S. fisheries of August 19-23 against the available U.S. TAC under different scenarios: based on the PSC or Canadian recommended run sizes, with or without the catch associated with U.S. fish tickets that were not reported in-season.

Available U.S. TAC on Aug 18	
Based on PSC recommended run sizes	235,950
Including missing U.S. tickets before Aug 18	222,907
Based on Canadian recommended run sizes	119,850
Including missing U.S. tickets before Aug 18	106,807
Predicted catch of U.S. fisheries for Aug 19-23	102,400

Of the 13,043 sockeye caught before August 18, it is estimated that 1,406 were Early Summer run sockeye. Based on the U.S. criteria to evaluate small but acceptable incidental harvest, the U.S. catches reported post-season would not have affected the U.S. fisheries proposal as the projected total incidental harvest of 3.0% would have remained lower than 3.3%.

Conclusion

- When including the U.S. fish tickets that were unreported in-season (33,529 sockeye, 13,043 of which reflect catch prior to August 18, 2022):
 - the available total U.S. TAC remained greater than the predicted U.S. fisheries catch even if run sizes recommended by Canada were adopted and;
 - the U.S. evaluation criteria for small but acceptable incidental harvest of Early Summer run would still have been satisfied.

3. Did the U.S. sufficiently consider the concerns raised and suggestions provided by Canada on August 18?

Concerns from Canada (Canadian response, Appendix 2.A):

- *The proposed run size recommendations for Summer and Lates ... were overly optimistic.*
- *Canada recommended that a more appropriate run size for Summer run sockeye should be the PSC in-season model estimates of 3,762,000. For Late run sockeye Canada recommended the p25 run size of 1,604,000.*
- *Canada also suggested that ... the Panel should consider not adopting any of the recommendations during this meeting and reconvene on Friday, August 19 to re-evaluate the situation with one more day's worth of information.*
- *Options for significantly reduced fisheries from those being proposed by the U.S. were being considered in the Chair to Chair discussion, but were not accepted by the U.S. Caucus.*
- *Canada ... believed that the outcome from the proposed fisheries would result in the possible elimination of commercial and recreational opportunities in Canada.*
- *The concerns expressed by Canada during the Panel meeting and Chair to Chair discussions were not adequately considered by the U.S.*

3a. Did the U.S. adjust its fisheries proposal in response to in-season information and Canada's concerns (in comparison to the pre-season plan and to Canada's proposed options for significantly reduced U.S. fisheries)?

In order to assess how the U.S. adjusted its fisheries proposal in response to in-season information, the U.S. fisheries proposal was compared against the pre-season fishing plan. The base case fishing plan adopted by the Panel assumed all management groups would return at median forecast levels. Compared to this plan, the U.S. significantly reduced its proposed fisheries, both prior to and during the August 18 Panel meeting. Prior to August 18, the U.S. delayed the opening of the Treaty Tribal fisheries in Areas 4B,5, 6C by two days, and in Areas 6, 7, 7A by six days. They also reduced the number of planned Treaty Tribal openings in the first half of August for Areas 6, 7, 7A from three to two days, and eliminated an All Citizen fishery originally planned for August 14th. In-season reported U.S. catches up until August 17 were also approximately 100,000 lower than the catches projected in the pre-season plan. At the August 18 meeting, the U.S. adjusted its fishery proposal in comparison to the preseason p50 plan by reducing Treaty Tribal fisheries in Areas 6, 7, 7A from four days to one day but maintained the one day All Citizen fishery opening (Table 5).

Table 5. Comparison of the U.S. fishery proposal of August 18, 2022, to expected fisheries as modelled preseason under the p50 forecast scenario (median forecasts assumed for all management groups) and under the p25 scenario (25th percentile of the forecasts assumed for all management groups). The comparison is done for the combined Treaty Tribal fisheries in Areas 6, 7 and 7A and the All-Citizen fishery in Area 7A in terms of the number of days these fisheries were expected to be open and their relative

contribution to total U.S. catches for this period (minor Treaty Tribal fisheries in Areas 4B, 5 and 6C also occurred, but have been excluded from the table). Note that only the p50 modelling scenario contained Canada's timing and diversion rate forecasts and were presented and discussed by the Panel. The p25 scenario was modelled by the Technical Committee using historical timing and diversion rate estimates and therefore was not presented to the Panel.

Proposed U.S. fisheries (Aug. 19-23)	Treaty Tribal Area 6, 7, 7A	All Citizen Area 7A
Proposed in-season fisheries		
# of days of fisheries	1	1
Proportion of observed U.S. catch	63%	36%
Preseason expectations under p50 scenario		
# of days of fisheries	4	1
Proportion of expected U.S. catch	66%	36%
Preseason expectations under p25 scenario		
# of days of fisheries	2	0
Proportion of expected U.S. catch	97%	0%

While the evaluation of the U.S. fisheries proposal in comparison to preseason fisheries plans (Table 5) is reasonable, it should be noted that while the model run based on the p50 forecast has been approved by both countries, Canada did not approve of the associated fisheries plan given the impact of U.S. fisheries on Early Summer run sockeye (2.8% incidental Early Summer run harvest in excess of the TAC). In addition, unlike previous years, the fisheries plan based on p25 forecasts had been executed by the Technical Committee but had not been presented to, and discussed by, the Panel. The p25 fishery scenario still contained historical estimates of timing and diversion because Canada's forecast was not available before the Technical Committee meeting. Regardless of the historical inputs and the unofficial nature of this preseason planning model, it still provides some background regarding the context within which the U.S. fisheries proposal accounted for in-season information versus pre-season information.

It was not possible for PSC staff to assess the difference between the U.S. fisheries proposal and the Canadian proposal for U.S. fisheries. While Canada indicated it suggested significantly reduced U.S. fisheries in a Chair-to-Chair discussion, details of this proposal were neither detailed during bilateral Panel meetings nor disclosed to PSC staff.

Conclusion:

- In comparison to the pre-season plan, the U.S. adjusted its fisheries proposal in response to the in-season information.
- The timing and number of fisheries openings were more consistent with modeled fishing plans for the p25 run size forecasts than the p50 forecasts.
- The p25 modelling scenario remains the best proxy for understanding whether the U.S. adjusted their fisheries planning in response to in-season information but unlike previous years, it was not reviewed by the Panel.
- Details regarding Canada's options for significantly reduced U.S. fisheries were not publicly disclosed and therefore were not evaluated by PSC staff in this report.

3b. If the U.S. would have adopted the alternative run size recommendations by Canada, how would the U.S. fisheries proposal have been affected?

If the U.S. adopted the run sizes for Summer and Late run sockeye that Canada recommended on August 18, 2022, the available U.S. TAC on that date still permitted the predicted U.S. catch of 102,400 by a margin of 17%. Therefore, the U.S. could have justified their fishery proposal with the same arguments outlined in their letter of rationale.

Conclusion

- If the U.S. would have adopted the run sizes recommended by Canada, the proposed U.S. fisheries would still be defensible given that the predicted U.S. catch did not exceed the available U.S. TAC.

3c. How would run size estimates and fisheries recommendations have differed if they had been delayed until Friday August 19?

Canada requested a delay to run size recommendations and fisheries plans and said that reconvening on Friday August 19 would provide one more day of information. While the Friday meeting did not occur, PSC staff did provide the Panel with the updated distribution of in-season information on that day. This facilitates a comparison of the information available on August 18 and 19.

On August 18, PSC staff reported that the run size model had not yet detected the peak of the Summer and Late run (test fishing CPUE and hydroacoustic estimates continued to increase). PSC staff said traditional time-density models could be underestimating the run size. On August 19, time-density models indicated a total Summer-run run size of 4 million in comparison to 3.8 million on August 18. The estimated run timing remained the same (August 15), indicating that the peak of the run may have been observed. For Late run, the run size estimate increased by 16% in comparison to the estimate on August 18 but, more importantly, the run timing changed from August 13 to August 15, indicating a substantial shift towards later timing with the additional data.

Conclusion

- Delaying fisheries recommendations by one day until August 19 could have had an impact on run size recommendations but not to the extent that it would have impacted the outcome of the PSC staff evaluation of the U.S. fisheries proposal.

4. What were the consequences of the U.S. fisheries of August 19-23?

Concerns from Canada (Canadian response, Appendix 2.A):

- *The U.S. catches exacerbated Canada's ability to plan FSC fisheries.*
- *Following the U.S. fisheries, the U.S. harvest of Late run eliminated any commercial or recreational opportunities that were being considered during the following two weeks.*
- *The impact of the U.S. decision had serious consequences on Canadian First Nations FSC and economic opportunity fisheries as well as commercial and recreational fisheries and resulted in no test fishery pay fish being retained in 2022.*

4a. To what extent did the U.S. exceed its share of the TAC for 2022?

According to Chapter 4, paragraph 3a, the annual U.S. share of the TAC is calculated based on the last in-season run size estimates adopted by the Panel. This occurred on Sept 28, 2022 (Table 6). The U.S.

share of the TAC based on these run size estimates totaled 326,220 sockeye. The U.S. catch, including the missing U.S. fish tickets totaled 352,580 sockeye, thereby exceeding the TAC by 26,360 sockeye.

Table 6. Overview of the information available on September 28, 2022, when the Panel adopted the last in-season run size estimates.

	E. Stuart	E. Summer	Summer	Late run	Total
Last in-season Panel-adopted run size estimates (Sept 28)	244,000	607,000	3,805,000	2,150,000	6,806,000
Total U.S. TAC	0	0	221,260	104,960	326,220
Total U.S. catch, including missing U.S. fish tickets	280	18,900	202,180	131,220	352,580
Remaining U.S. catch balance	-280	-18,900	19,080	-26,260	-26,360

Conclusion:

- The U.S. share of the TAC is calculated based on the last in-season run size estimates adopted by the Panel. Based on these estimates, the U.S. exceeded its share by 26,360 sockeye.

4b. If the U.S. would have adopted the alternative run size recommendations by Canada on August 18, how would this have affected the U.S.?

According to Chapter 4, paragraph 8(c)(iv), U.S. overages are calculated based on run size estimates adopted by the Panel when the last U.S. fishery of the season is approved by the Panel, which in 2022 was August 18. If the run sizes recommended by Canada had been adopted at this meeting (6,237,000), and given the post-season U.S. catch numbers, including the missing U.S. fish tickets, the U.S. would have exceeded its TAC by 84,120 sockeye, resulting in a substantial pay-back (Table 7). In comparison, based on the run sizes recommended by PSC staff on August 18, the U.S. would have a remaining catch balance of 32,440 sockeye, requiring no adjustment of future U.S. shares of the TAC.

Table 7. Predicted U.S. catch balance based on different assumed run sizes at the August 18 meeting, when the Panel approved the last U.S. fisheries of the 2022 season. Run sizes adopted at this meeting determined any overages and potential fish pay-back. Catch data used in this evaluation are based on post-season reports and include the U.S. catches that had been unreported in-season.

End-of-season US catch balance (overage)	Total sockeye
Based on PSC recommended run sizes on Aug 18	32,440
Based on Canadian recommended run sizes on Aug 18	-84,120

Conclusion:

- Overages of the U.S. share of the TAC are estimated for pay-back purposes based on the in-season run size estimates adopted by the Panel at the meeting when the Panel approves the last U.S. fishery. The run sizes recommended by PSC staff on that date (August 18) do not require any payback.
- If, on August 18, the Panel instead adopted the run size estimates for Summer and Late run recommended by Canada, the U.S. would have exceeded its TAC by 84,120 sockeye, resulting in a substantial payback.

4c. To what extent did the run size and fisheries recommendations on August 18 impact Canadian fisheries?

U.S. fisheries from Aug 19-23 caught a total of 171,231 Fraser sockeye. The majority of these were Summer run but 73,388 were Late run sockeye. Because it is unclear to what extent Canada suggested the U.S. should adjust its fisheries proposal during Chair-to-Chair discussions, we explored the consequences of the most extreme option and evaluated how it may have impacted Canada if no U.S. fisheries would have occurred following the August 18 meeting. This allows us to evaluate the extent to which FSC catches as well as the timing and magnitude of Canadian commercial and recreational catches were affected. For this evaluation, some assumptions had to be made, based on the best available information, either from past years or from the fisheries planning model (Hague 2022).

If no U.S. fisheries had taken place on Aug 19-23, additional Canadian Late run TAC (73,388 sockeye) would have likely been allocated to FSC fisheries. Impacts on marine FSC fisheries would likely be small, given that their preseason catch target of 266,800 sockeye was reached before August 23, when the impact of the U.S. fishery on available TAC was known. By the end of the season, marine FSC fisheries had caught 325,990 Fraser sockeye.

First Nations catches within the Fraser River (Lower Fraser and BC Interior), in contrast, fell short of their pre-season target of 784,000, catching 499,386 sockeye or 64% of the Fraser River First Nations FSC allocation. This was despite the fact that any in-river fisheries north of the Fraser River and Thompson River confluence (just north of Lytton) were able to target Summer run sockeye without Late run impacts. Also, Late run sockeye delaying in the Strait of Georgia substantially reduced the impact of in-river fisheries on Late run sockeye in comparison to other fisheries (50% of the Late run entered the Fraser River after September 12, while 50% of the Summer run entered the river after August 21).

The shortfall in FN catches in the Fraser River was borne mostly by First Nations in the BC Interior. Whereas lower Fraser FN catches of sockeye (342,940) were similar to catches in 2018 (361,923) when overall abundances in the Fraser were larger, FN 2022 catches in the BC Interior (156,466) were considerably smaller than in 2018 (245,232). In 2022, about 24% of FN catches in the river occurred after the impact of the U.S. fishery on the available TAC was known; in 2018, those later catches constituted 29% of the total. Given the distribution (in both time and space) of FSC catch differences in 2022 versus 2018, PSC staff consider it likely that the smaller run size and possibly decreased in-river fishing effort were the main reasons for the lower catch in 2022 than in 2018. The effect of the August 19-23 U.S. fisheries on FSC catches appears to have been minor. Even if Canadian in-river FSC catches could have been increased by 171,231 sockeye, they would still fall 15% short of their pre-season target.

As PSC staff are not involved in domestic discussions on what instigates consideration of First Nations Economic Opportunity (EO), commercial, or recreational fisheries, preseason fisheries plans have been used as a basis for comparison. It should again be noted that, unlike previous years, the Panel only reviewed the fisheries planning model based on the p50 forecast and adopted this as a base case. The Panel did not review the fisheries planning model executed by the Technical Committee based on the p25 forecast. However, on August 18, Canada indicated that the p25 forecast was more appropriate than the PSC-recommended run size for Late run. Therefore, the p25 model has been used here to evaluate the extent to which Canada may have planned EO, commercial, and recreational fisheries. At p25 abundances, the fisheries planning model indicated Canada would only execute FSC fisheries.

After the U.S. fishery of Aug 19-23, the Late-run estimate did not exceed the p25 forecast until the September 6 meeting. Therefore, it is unlikely Canada would have scheduled any EO fisheries or

commercial and recreational fisheries prior to that date, even if the August 19-23 U.S. fisheries had not occurred and the Canadian balance of the TAC was larger as a result.

On September 6, Canada proposed commercial ITQ fishery openings in the Fraser Panel Area: an Area B purse seine fishery in Area 29 and an Area H troll fishery in Area 29. Following these fishery openings (Sept 8-10), these two fisheries combined caught about 78,700 sockeye (75,400 Late run and 3,300 Summer run). If no U.S. fisheries occurred on August 19-23, Canada would have had an additional Late run TAC of 73,388 (Table 8). Assuming all additional Late run TAC would have been assigned to commercial fisheries and Areas B and H would be allocated 53% (based on preseason allocation plans), this would result in an additional Late run catch of about 39,000, or 40,000 total when including Summer run sockeye. Overall, the additional TAC available if the U.S. did not execute its August 19-23 fisheries would have a limited impact on potential Canadian catches in Area 29, given that the U.S. fishery targeted the more abundant Summer run sockeye while Area 29 fisheries catches consisted almost exclusively of Late run sockeye.

Table 8. Potential additional ITQ for combined commercial Area B and H fisheries in Area 29 assuming no U.S. fishery would have occurred on Aug 19-23, 2022, and assuming all additional TAC to be allocated to commercial fisheries, with 53% assigned to Areas B and H. Given that catches in Area 29 were dominated by Late run, the TAC available for this management group determined potential additional catches.

	E. Summer	Summer	Late	Total
Additional available TAC assuming no U.S. fishery took place on Aug 19-23	3,702	94,141	73,388	171,231
Additional ITQ for Area B and H fisheries				
Assuming all additional TAC would be allocated to commercial fisheries	0	1,695	38,727	40,422

Since Canadian commercial fisheries were not considered until September 6, it was not possible to have an Area E gill net fishery opening, given that Canada's IFMP (DFO 2022) stipulates that such a fishery would not be considered after the Interior Fraser Coho closure was initiated (this closure was initiated on September 6 in 2022). The Area D gill net fishery is managed as an open, competitive (derby-style) fishery in Areas 11 to 13. By September 6, almost all the Fraser sockeye had migrated through this area and therefore the Area D fishery opening only managed to catch 721 sockeye. U.S. fisheries on Aug 19-23 were not responsible for the limited openings and catches for Area E and Area D.

Conclusion:

- Given in-river fisheries were able to target mainly Summer run sockeye following the U.S. fisheries of August 19-23 and the similar challenge of achieving FSC catch allocations in 2018 when abundances were larger than in 2022, it can be considered unlikely the August 19-23 U.S. fisheries had a substantial impact on Lower Fraser FN fisheries not reaching their catch allocations.
- Even if the U.S. fisheries would not have occurred on Aug 19-23, and the Canadian balance of the TAC would have been larger as a result, scheduling EO, commercial, or recreational fisheries before September 6 would have been very challenging as the Late-run run size was still at the p25 forecast level.
- If the U.S. fishery did not occur on Aug 19-23 and all additional Canadian TAC was assigned to commercial fisheries, the main impact would be that the combined Area B and Area H allocation for ITQ would increase by 40,000 sockeye.

- The U.S. fisheries on Aug 19-23 caused neither the low catch of the Area D fishery nor the complete closure of the Area E fishery.

4d. Were run size and fisheries recommendations on August 18 responsible for the lack of pay fish retention in 2022?

According to the PSC Test Fishing Policy (2021), decisions regarding pay fish retention are informed by harvestable surpluses *inter alia*. For Early Stuart and Early Summer-run sockeye, there were no harvestable surpluses in 2022. This required the Panel to avoid taking pay fish containing these management groups. Once the proportion of Early Summer run had decreased sufficiently to consider pay fish retention, the limited and uncertain harvestable surplus for Late run and the challenges of Canada to meet FSC and FN domestic allocations objectives further prevented pay fish retention. On September 6, the Late-run run size had increased sufficiently for Canada to consider commercial and recreational fisheries but it had been too late to take pay fish given that purse seine test fisheries were terminated by September 5 (after most of the Summer and Late run had moved through the marine areas).

Had the U.S. fishery not proceeded on August 19-23, 44,336 in Late run international TAC would have been available on August 23 and it is reasonable to assume that the Panel could have reconsidered pay fish retention. Whether Canada and the U.S. would have been willing to allocate some of their limited Late run TAC toward pay fish cannot be determined objectively without knowledge of their domestic priorities. In the absence of the August 19-23 U.S. fisheries, the Panel could have continued to consider the retention of pay fish given the harvestable surplus for Late run but Canada's ability to meet domestic treaty obligations prior to September 6 is more difficult to determine (see 4c).

Conclusion:

- Following directions of the PSC Test Fishing Policy, no pay fish was taken in 2022 due to the lack of harvestable surpluses for Early Stuart and Early Summer run stocks, the limited and uncertain harvestable surplus for Late run stocks, and Canadian concerns to meet FSC and FN domestic allocations objectives.
- The U.S. fisheries proposed on August 18 eliminated the remaining Late run TAC until September 6 when an increase in Late-run run size generated TAC that could be allocated to pay fish. During this period, Canada had not yet met their domestic treaty obligations in order to approve the retention of pay fish and the U.S. did not have any available TAC.
- It is not possible to objectively determine whether Canada would have approved the retention of pay fish had the August 19-23 U.S. fishery not proceeded, but had the 73,388 Late run sockeye not been caught, international TAC would have remained available and pay fish allocation could have continued to have been considered alongside Canada and the U.S. domestic priorities.

Recommendations

Below is a list of recommendations, in no particular order, based on the meeting events of August 18 as well as some of the analyses that have been part of this review. These however will require further discussion with both the Panel and Technical Committee in terms of the extent they should be implemented. This is not an exhaustive list as the Panel and Technical Committee may have additional recommendations.

- In 2022, Canada raised concerns about meeting escapement goals, given the in-season adopted run sizes. Instead of selecting more conservative (lower) run size estimates in-season, and raising

debate about risk tolerance during management decisions, pre-season agreements could be explored to be more cautious based on in-season information:

- In years with low run sizes and potential conservation concerns for some of the stocks, the Panel could use a more conservative approach for these stocks when selecting the Management Adjustment (MA) that determines the harvestable surplus. Instead of adopting MAs based on average en route losses and waiting for in-season observations of en route mortality, the Panel could rely instead on in-season observed and forecasted estimates of river temperature and discharge, and allow the MA to be updated if thresholds are exceeded, i.e. using the supplemental MA approach. On average, this will make the adopted MA too conservative, but might be an appropriate strategy in low run size years and for stocks for which there are conservation concerns. Implementation of this strategy in 2022 would have seen the MA for Summer run increased on August 18 instead of September 2.

Recommendation 1: Consider increasing the MA based on in-season observed and forecasted estimates of river temperature and discharge exceeding thresholds instead of waiting for in-season confirmation of en-route losses, in years with low run size or for stocks with potential conservation concerns.

- In-season assessments for Late run salmon (and pink salmon) are relatively uncertain given their delay in the Strait of Georgia before continuing their upstream migration, making it impossible to confirm daily abundances (based on marine test fishing data) with Mission hydroacoustic census 6 days later. Run size uncertainty is, however, not taken into account within the Fraser River Sockeye Spawning Initiative (FRSSI), DFO's multi-year collaborative planning process to develop a long-term escapement strategy. Instead, the management strategy evaluation assumes perfect in-season run size knowledge, and the only assessment uncertainty stems from the in-season MA prediction deviating from the actual MA. Appropriately accounting for the additional assessment uncertainty when setting escapement goals for Late run (and pink salmon) could alleviate the in-season conservation concerns raised by Canada.
 - **Recommendation 2:** Take into account run size assessment uncertainty when setting escapement goals for Late run (and pink) salmon.
- The Fraser River Panel plans for any upcoming season by evaluating different fisheries proposals given different assumptions about run size, i.e. different preseason forecasts, in addition to different assumptions about other biological parameters such as diversion rates and timing. While it is understood these pre-season plans are less useful once in-season information becomes available, they are valuable and allow the Panel to have important and difficult discussions pre-season, instead of dealing with difficult situations for the first time in-season. In 2022, the fisheries planning tool (Hague 2022) had not been used as effectively as in previous years, given that the base case adopted by the Panel contained U.S. fisheries that did not fully meet Canada's criteria of small but acceptable catch of Early Summer run sockeye, and no model results assuming lower run size estimates had been presented to the Panel.
 - Unlike previous years, the base case pre-season fisheries planning model was accepted by both countries without the U.S. fisheries meeting Canada's criteria of the catches of Early Summer run being small but acceptable. Additional adjustments to the pre-season fisheries planning model to ensure the U.S. fisheries met Canada's criteria for Early Summer run would have better prepared both countries for the upcoming season by allowing more of the in-season discussion to occur preseason, and allowing adjustment of expectations prior to the pressure of the in-season period.

Recommendation 3: The base case fisheries planning model adopted by the Panel should include fisheries that meet both countries' criteria of small but acceptable catch for management groups with limited or no TAC.

- In 2022, the Technical Committee only received Canada's forecasts for timing and diversion rate after it had completed its June pre-season meeting and the Panel meeting had already started. While the Technical Committee reconvened to make adjustments to the model, only the base case scenario was adjusted and subsequently presented to the Panel, leaving the Panel no opportunity to discuss management restrictions and fishing opportunities in case returns would be smaller than forecast

Recommendation 4: Canada should ensure timing and diversion rate forecasts are provided to the Technical Committee ahead of its June meeting.

Recommendation 5: Pre-season, the Panel should be presented with and discuss results of the fisheries planning model assuming alternative run size scenarios.

- For in-season assessments, it is *essential* that both Parties provide accurate and timely catch information to PSC staff. This information is critical to the Fraser Panel management process. Underreporting of catches in-season will lead to underestimation of reconstructed abundance (which is based on hydroacoustic data in combination with catch data), underestimation of the run size, and overestimation of the remaining catch balance. Post-season in 2022, the U.S. reported 33,529 sockeye that were not reported in-season.

Recommendation 6: The U.S. (and Canada) should ensure catches reported to PSC staff are timely and accurate.

- The Pacific Salmon Treaty acknowledges that U.S. fisheries concentrated on the most abundant management groups may result in more than 16.5% of the TAC for management groups that are less abundant. While the Treaty specifies that this incidental harvest may be small but acceptable, no further guidance on defining these terms is provided. This compels both countries to agree on what constitutes a small but acceptable harvest.
 - The criteria of small but acceptable harvest seems to cause most disagreement when applied to management groups for which there is no international TAC, both in 2021 when the U.S. wanted to access pink salmon (thereby impacting sockeye) and in 2022 when the U.S. tried to access Summer run sockeye (thereby impacting the Early Summer run). According to Canada's Integrated Fisheries Management Plan (IFMP), Low Abundance Exploitation Rates (LAERs) allow for incidental harvest on co-migrating stocks for which there is no available TAC. In 2022, the LAER for Early Summer run was 20%. The U.S., in its rationale letter, considered it reasonable that the U.S. proportion of the LAER would be 16.5%, or 3.3%. Canada has not used the same criteria to evaluate small but acceptable catches in case there is no international TAC.

Recommendation 7: Ahead of the 2023 fishing season, Canada and the U.S. should have further discussions about the small but acceptable criterion for management groups without international TAC, including the scenario when no Fraser sockeye management groups have international TAC during pink years, and the scenario for fisheries that have high incidental harvest rates (e.g., gill net fisheries when targeting pink salmon).

Recommendation 8: Canada and the U.S. should evaluate to what extent it is appropriate to rely on a proportional share of the Low Abundance Exploitation Rates (LAERs) to define small but acceptable incidental harvest rates when no international TAC is available for some management groups.

- When proposing Area 7 and 7A fisheries in-season, the U.S. prefers to schedule consecutive Treaty Tribal and All citizen fisheries over multiple dates. Both the fishing conditions as well as

information available to assess the appropriateness of the proposed fisheries may however change considerably between the approval and the end of the fisheries.

- On August 18, following objections from Canada regarding the amount of fishing planned by the U.S., PSC staff suggested the U.S. could implement a check-in, allowing the U.S. to shorten its fisheries in case the U.S. TAC would be exceeded. This wasn't considered practical by the U.S.

Recommendation 9: The U.S. could consider a) decoupling consecutive Treaty Tribal and All Citizen fisheries in Area 7 and 7A, requiring an additional Panel meeting in between or b) improving the ability of the U.S. to check Treaty Tribal catches prior to proceeding with All Citizen fisheries or vice versa.

- The ability of PSC staff to predict catches based on proposed fisheries degrades as fisheries are planned further into the future, given the changes in fishing conditions over time (diversion rate, abundance, catchability, etc.).

Recommendation 10: Fisheries proposals not more than three days into the future may be better. Additional fisheries further into the future could require an additional FRP meeting, or extensions of fisheries openings could be done by establishing improved communications for transmittal of information to crews in the field.

- In-season, the Panel relies predominantly on data, information and analyses provided by PSC staff to make its fisheries management decisions. It is important that this information is clearly communicated and vetted by the Technical Committee (TC) prior to communicating results to the Panel. In addition, it is important for PSC staff to clearly communicate the rationale behind its recommendations but also feel that it is acceptable not to make a recommendation when there is insufficient information to recommend an updated run size.
 - In-season, the TC meets weekly to review a detailed version of the in-season data. At these meetings, the TC acts as a sounding board for PSC staff regarding current run size assessments. They have the opportunity to question the assessment approaches and suggest alternative analyses (Roles and Responsibilities document 2022). Normally these TC meetings occur every Thursday, ahead of the Friday Panel meeting. This leaves sufficient time for staff to make adjustments to the distributed meeting information package, if needed, prior to the Panel meeting. On Thursday August 18, the Panel meeting was combined with the Technical Committee meeting, following a request from the U.S. This resulted in PSC staff presenting additional technical information to the Panel, thereby making the communication of the available information more technical compared to the usual Panel format. In addition, the combined meeting limited the ability of the Technical Committee to question the methods and results presented, given the Panel's focus on run size estimates and recommendations.

Recommendation 11: Technical Committee meetings should be held independently from Panel meetings, i.e., not combined and not replaced by Panel meetings.
 - In-season, PSC staff rely on a wide range of different models to estimate run sizes for the different management groups. Especially early in the season, when insufficient data are available to rely on traditional run size estimates, staff may rely on alternative assessment methods to provide an early indication of the run size. These methods may, however, have known biases or rely on data of lower quality compared to more traditional methods. When presented to the Panel, it is important to indicate this additional information in the distribution and not just verbally, especially when making decisions regarding which model to rely on for run size recommendations. Additional information about the model and data quality could also be conveyed at the Panel meeting to better understand when it should be considered too early in the run for PSC staff to make run size recommendations.

Recommendation 12: When presenting alternative run size estimates based on models with known biases or with expected data quality issues, PSC staff should do a better job of communicating these issues.

Recommendation 13: PSC staff should indicate when there is insufficient in-season information available to make run size recommendations instead of recommending a run size equal to the forecast.

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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 January 2020. (<https://www.psc.org/publications/pacific-salmon-treaty/>)

August 19, 2022

Mr. Les Jantz
Vice-Chair, Fraser River Panel

RE: Rationale letter in support of US proposed Fraser Panel fisheries, under Chapter 4,
Section 13(d) iii of the 2019 Pacific Salmon treaty

Dear Mr. Jantz:

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. 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 one National Section of the Panel can accept the recommendations put forward by the PSC staff and propose fishery regulations, within their domestic Panel waters, when the other National Section of the Panel does not support the PSC staff in-season recommendation or the other 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 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).

The Fraser River Panel met at 1:00pm on August 18, 2022, for an in-season Panel meeting. This meeting took place one day earlier than scheduled, as the U.S. was interested in potentially opening an All-citizen’s commercial fishery as early as Friday, August 19th, should the in-season assessment support it. At this meeting, which was a combined Panel and Technical Committee meeting, the PSC staff went over the latest “distribution” document of updated Fraser River sockeye salmon run assessment. After reviewing the available information and based on the updated analysis of the management group-specific timing and abundance information, the PSC staff recommended to the Panel the following:

Early Stuart management group: No change to the Panel adopted run size or timing;

Early Summer management group: Increase run size from the prior adopted 614,000 to 627,000, with an associated run timing of July 31.

Summer management group: Keep this group at it’s forecasted (p50) run size of 4,403,000, but shift the run timing five days later to August 15.

Late management group: reduce the run-size estimate down to 2,000,000, from the 3,688,000 forecasted pre-season, given the early, indications of low abundance in the test fisheries, relative to pre-season expectations, as well as a sensitivity analysis comparing several models estimating potential run size, which all estimated that the Late-run fish were likely to return in numbers significantly lower than the pre-season forecast. No change to the run timing was recommended.

The PSC staff also presented estimates for likely fisheries that could be planned in the near term, which included estimated total and management-group specific harvest estimates for the U.S. All citizen and Treaty Indian fisheries in Areas 4b, 5, 6c and Areas 6, 7, and 7A, specific to the gears used there.

The U.S. National Section of the Panel then met in a caucus to deliberate the recommended updates, what they meant for the available total allowable catch (TAC) of Fraser sockeye in U.S. Panel fisheries and to craft a potential fishery proposal, if TAC was available.

The PSC staff distributed a TAC table, updated to reflect the changes in management group run size that they had proposed. The following levels of TAC available to the U.S., under the recommended run size adjustments, as well as the status of U.S. and Canadian catches to date were as follows:

Table 1.

	Early Stuart	Early Summer	Summer	Late	Total
Run size	244,000	627,000	4,403,000	2,000,000	7,274,000
TAC for International Sharing	0	0	1,879,417	454,103	2,333,520
Canadian TAC+AFE (83.5%)	0	55,000	1,753,830	540,130	2,348,960
Total CAN catch to date*	2,820	40,070	197,540	51,602	292,040
Difference	-2,820	41,989	1,553,900	486,448	2,079,517
U.S. TAC (16.5%)	0	0	309,720	74,840	384,560
Total U.S. catch to date	0	12,810	85,270	41,220	139,300
Difference	0	-12,810	224,450	33,620	245,260

*As of

8/18/2022, all Canadian harvest was from First Nations Food, Ceremonial, and Social fisheries.

The U.S. Section of the Panel developed a proposal for the following fisheries:

TREATY TRIBAL FISHERY:

Areas 4B, 5, and 6C: Extend for drift gillnet fishing from 12 p.m. (noon), Friday, August 19, 2022, through 12 p.m. (noon), Wednesday, August 24, 2022.

Areas 6, 7, and 7A: Open for net fishing from 5 a.m., Sunday, August 21, 2022 through 9 a.m., Monday, August 22, 2022.

ALL CITIZEN FISHERY:

Areas 7 and 7A: Open for purse seine fishing from 5 a.m. through 9 p.m., Saturday, August 20, 2022.

Areas 7 and 7A: Open for drift gillnet fishing from 8 a.m. through 11:59 p.m., Saturday, August 20, 2022.

The PSC staff estimated that the proposed U.S. fisheries would result in additional catches, by management group, of the following amounts, based on current in-season projections.

Table 2.

	Early Stuart	Early Summer	Summer	Late	Total
Treaty Tribal	Current In-season Catch Projections				
4B, 5, 6C	0	0	1,000	500	1,500
6, 7, 7A	0	1,200	19,200	7,800	28,200
All Citizens					
7/7A	0	1,000	18,900	10,800	30,700
Total	0	2,200	39,100	19,100	60,400

The Canadian National Section, after deliberating on the recommended run sizes and timings, and after discussions between the Panel Chairs, supported the recommendation for the increase to the abundance of Early Summer management group and the shift of its timing to July 31. They did not support the Summer management group remaining at the p50 abundance, nor the shift of the group's timing later to August 15. They also did not accept the recommendation to only reduce the Late management group to 2.0m and suggested that the p25 forecast of 1.6m was warranted, given several factors of concern. In particular, the Early Summer management group, as a whole, is likely to end up below the p25 abundance level. Additionally, the timing of the group is estimated to be six days earlier than the preseason forecast. The performance of this group is due to the significantly lower than expected return of the Early South Thompson and Barriere stocks, which were forecasted to make up 1.3m of the 1.6m total Early Summers. The current estimated Early Summer run size is 627,000.

The Canadian National Section of the Panel was concerned that the Summer-run is not likely to meet the p50 forecast and was frustrated that the PSC staff had not recommended to adopt the lower, in-season estimate of 3,762,000 that was presented in the run size and timing estimates table in the distribution. The PSC staff explained that the information to date was still too uncertain to recommend reducing the Summer run size. Additionally, the Canadian Section of the Panel was also very concerned that the recommendation of the 2.0m run size, for the Late-run management group, was too optimistic, citing the multi-model sensitivity comparison the lack of late-run stocks in the test catches and the performance of the Early South Thompson (E. summers), which has been used in recent years to estimate the likely in-season run size of Late-run, Shuswap/Portage stocks, as they tend to delay in the marine areas (gulf), making Mission hydroacoustic estimates less affective.

In the end, the Canadian National Section felt that a complete pause on all fisheries was warranted.

The U.S. National Section considered all of the Canadian concerns. Initial discussions within the U.S. caucus considered fishery proposal of up to three total commercial openers—one All citizen's and two treaty tribal, as by our review of the status of the runs given the PSC staff recommendation, we calculated that we likely had the sufficient available TAC in the Summer and Late-run management groups to accommodate these fisheries. However, after further consideration of the Canadian concerns, the U.S. caucus decided on the proposal for the two commercial openers, as described above.

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

“...The annual U.S. share of sockeye available for harvest in the Panel Area is computed by applying the percentage share provided in paragraph 2(a) [16.5%] to the aggregate TAC, defined as the sum of the TACs computed for each of the four stock management groups. To the extent practicable, the Fraser River Panel shall develop and implement a fishing plan that provides the U.S. fishery with the opportunity to harvest its 16.5% aggregate share of the TAC of Fraser River sockeye”. And that,

“To accomplish this, the Panel to the extent practicable, shall strive to concentrate the U.S. on the most abundant management group (or groups), i.e., those that provide the largest percentage of the available TAC”.

Subsection (e) also states that:

“It is understood that, despite concentrating the U.S. harvest in this manner, the overlapping of the management groups may result in greater than 16.5% of the TAC for one or more of the less abundant management groups being taken in U.S. fisheries. 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”.

As shown in Table 1, the estimated TAC available to the U.S. fisheries totaled 245,260 sockeye catch remaining balance as of August 19, 2022, with the majority coming from the Summer management group and to a lesser extent from the Late-run group. Currently the U.S. has achieved only 36% of its available TAC and the current fisheries proposal is estimated to increase that percentage to only 52%. The proposed U.S. fisheries looked to focus their efforts on the Summer management groups abundance in U.S. Panel waters, as the in-season assessment indicted that this group was making up the majority of the abundance in U.S. waters and the Northern diversion rate was accelerating (16% August 12, 53% August 16, to 65% August 18), which indicates that the majority of the Fraser sockeye return has begun to migrate through the Johnstone Strait (Canadian waters) route and that the proportion of fish utilizing the Strait of Juan de Fuca (U.S. waters) will be diminishing. This would leave limited time for U.S. fisheries to harvest their available remaining TAC. The proposed U.S. fisheries were projected to catch a small portion of the total available remaining TAC (21.9%), based on current in-season projections. Additionally, PSC staff have identified that CPUE of test catch in Area 20 are continuing to increase, indicating a peak of Summers has yet to be reached, and that projected abundances of Early Summers is projected to decline to less than 1%. The most recent DNA sample from the A20 purse seine test fishery on August 16th showed zero percent Early Summers in the stock composition.

At a run size estimate of 627,000, as recommended by PSC staff, the Early Summer management group does not have available TAC for international sharing. The U.S. had already accumulated a catch of 12,810 Early Summers in the earlier Panel-approved fisheries prior to the August 18th Panel meeting. The proposed U.S. fisheries would likely add another estimated 2,200 fish to this total (Table 2), resulting in

Mr. Les Jantz
August 19, 2022
Page 6

a total of 15,010 Early Summer sockeye taken in U.S. fisheries. This would result in an exploitation rate of 2.4%, on the Early Summer management group in U.S. Panel fisheries at the recommended Early Summer run size of 627,000. It should also be noted here that even if the Early Summer run was being managed under a low abundance exploitation rate (LAER) of 20%, which it is not, a reasonable assumption regarding the U.S. portion of the LAER could be 16.5% of the 20% LAER, which is a 3.3% exploitation rate. The U.S. believes that the level of incidental harvest of the Early Summer management group in the proposed fisheries represents, reasonably, a small but acceptable impact in pursuit of harvesting the available U.S. TAC on the remaining management groups. Furthermore, impacts to Early Summers are projected to decline given their minimal detection in Area 20 test fisheries, and the continued increased detection of the Summers in test catches.

The U.S. Fraser Panel Section acknowledges the concerns raised by the Canadian section and has worked to craft our 2022 fishery proposals to be responsive to what the in-season assessment from the PSC staff tell us. The current U.S. fisheries, approved by the Panel on August 19 follow this same pattern of responsive management and are consistent with the obligations agreed to in the Chapter 4 of the 2019 PST.

Sincerely,



Mark Baltzell, WDFW
Fraser Panel Chair



Jason Gobin, Tulalip Tribe
U.S. Fraser Panel Co-chair



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October 14, 2022

Mr. John Field
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Tel. (604) 684-8081
Email: field@psc.org

RE: Requesting the Commission Staff to prepare a report on U.S. Fraser Panel Fisheries as per Pacific Salmon Treaty Chapter 4, Section 13 (e)

Dear John,

I am writing to follow-up on the most recent Fraser sockeye season; in particular, recent in-season decisions within the bilateral Fraser Panel. As outlined in the attached recent exchanges of correspondence between the Canadian and United States (U.S.) Fraser Panel Chairs, Canada has identified concerns regarding the process which led to the fishery decisions adopted by the U.S. during the August 18, 2022 meeting of the Panel.

In Canada's view, the Pacific Salmon Commission (PSC) Secretariat's run size recommendations during the August 18, 2022 meeting of the Fraser Panel, for both the Summer Run and Late Run returns, and the subsequent fisheries proposed by the U.S., were not consistent with the information available at that time. The outcome of these decisions had significant implications for First Nations food, social, and ceremonial, and economic fisheries in Canada, as well as commercial and recreational fisheries. Additionally, they also resulted in no test fishery pay fish being retained in 2022.

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 decision and its consequences. Our hope is that this report would be presented to the parties at the January 2023 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.

Sincerely,

Rebecca Reid
Lead Canadian Commissioner
Pacific Salmon Commission



Attachments:

1. Rationale letter for US Fraser Panel Fishery
2. Canada Response Letter to US

cc: Dr. Scott Rumsey, Commissioner, Pacific Salmon Commission
Lester Jantz, Canadian Vice-Chair, Fraser River Panel
Cara Fogliato, Canadian National Correspondent

Appendix 2.A

September 30, 2022

Mr. Mark Baltzell

Chair, Fraser River Panel

Re: Response to rationale letter in support of U.S. proposed Fraser Panel Fisheries, under Chapter 4, Section 13(d) iii of the Pacific Salmon Treaty.

Dear Mr. Baltzell:

Thank you for your letter outlining the rationale for the decisions made by the United States (U.S.) during the August 18 meeting of the Fraser Panel. While the U.S. members of the Fraser Panel followed the protocol as described in Chapter 4 of the Pacific Salmon Treaty in relation to proposing fisheries, I note that Paragraph 10 of Chapter 4 states "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".

In Canada's view, the decisions taken by the U.S. section of the Fraser Panel on August 18 placed more emphasis on the second and third Fraser Panel objectives rather than the first for the following reasons:

- The Pacific Salmon Commission (PSC) Secretariat staff run size recommendations for both the Summer Run and Late Run returns during the August 18 meeting were overly optimistic given the poor performances observed for the South Thompson Early Summer run returns and the earlier timing pattern exhibited by the entire Early Summer run timing group (page 17 in attachment). The projected run timing for the Early Summer Run timing group was estimated to be July 31 compared to the pre-season projected timing of August 6 (page 28 in attachment).
- The PSC Secretariate staff put less emphasis on this information and instead focused on a regression analysis which included the timing information for Early Stuart sockeye, Lake Washington sockeye and the pre-season forecast from DFO Science. This analysis suggested a return timing 3 days later than the pre-season Panel agreed timing, which then formed the basis for their run size recommendation for Summer run Sockeye.
- The PSC staff recommended a Summer Run size of 4,403,000, which was the p50 forecast return provided by DFO. The PSC reconstruction models (page 28) were suggesting that based on the catch plus escapement plus 6 day projections and seaward abundance, the Summer run return was in the order of 3,762,000. In order to get to the p50 run size, PSC staff assumed a run timing for the Chilko/Quesnel component of the Summer run return to be 5 days later than the pre-season adopted run timing and 2 days later than their regression analysis which Canada did not feel the in-season data supported.
- It is worth noting that the daily migration graphs (page 18 in attachment) showed a considerable increased abundance being projected for the next 6 days based on the increasing marine test fishery catches during the most recent time period. These projections were highly uncertain due to fluctuating expansion lines and reports of poor test fishery catches in Areas 12 and 20 on

August 18. Using this information to justify recommending the most optimistic run size for Summer runs of all the model runs presented was not conservative in Canada's view and did not take into account the uncertainty in the information.

- For Late Run Sockeye, the PSC staff provided six different assessments (second attachment) to inform a Late Shuswap/Portage sensitivity analysis. These assessments were presented early in the return when migration information was suggesting the Late Shuswap/Portage group was tracking between the p10 and p25 forecast level. The timing model suggested a return of approximately 2,000,000 Sockeye while the other 5 options produced run sizes ranging from 800,000 to 1,200,000, with the latter being consistent with the PSC staff model predictions. Rather than choosing a more conservative estimate based on all but one of the models, the PSC staff recommended the most optimistic run size of 2,000,000 which Canada did not support based on the information presented in the package.
- Before breaking into our respective Caucuses, Canada indicated that we were not supportive of the proposed run sizes for Summers and Lates—believing they were overly optimistic—but did support the run size recommendation for Early Summer run Sockeye of 627,000. Accordingly, Canada recommended that a more appropriate run size for Summer run Sockeye should be the PSC in-season model estimate of 3,762,000. For Late run Sockeye Canada recommended the p25 run size of 1,604,000 which was a compromise between the PSC recommendation of 2,000,000 and the PSC in-season model estimates of 1,206,000. Canada also suggested that, as an alternative, the Panel should consider not adopting any of the recommendations during this meeting and reconvene on Friday, August 19th to re-evaluate the situation with one more days worth of information.
- During the Caucuses, a chair and alternate to co-chair and alternate discussion was held between the two countries to try to negotiate a compromise to the situation as the U.S. was clearly willing to accept the run size recommendations and were proposing significant fisheries for the weekend. Options for significantly reduced fisheries from those being proposed by the U.S. were being considered in the Chair to chair discussion, but were not accepted by the U.S. Caucus.
- When the Panel reconvened following the Caucus discussions, the U.S. proceeded to accept the recommended run sizes and proposed extending the U.S. fisheries in 4b, 5, and 6c Treaty Tribal GN fishery through to August 24, an All Citizens GN & SN fishery in 6, 7 and 7A on August 20 and a Treaty Tribes GN & SN fishery in 6, 7 and 7a on August 21. The proposed fisheries were all evaluated and approved by the PSC staff. Canada did not support the run size and U.S. fishery proposals, which triggered implementation of the clause in paragraph 13 (d) (iii) and the subsequent rationale to be provide by the U.S. prior to the commencement of the All citizens fishery on August 20.
- Canada also expressed significant concern believing that the outcome from the proposed fisheries, would result in the possible elimination of commercial and recreational opportunities in Canada. The primary concern was the U.S. fisheries would harvest substantial numbers of Early Summer and Late run stocks which were constraining fisheries in both countries. In addition, Canada anticipated impacts from the proposed U.S. fisheries on Canadian First Nations food, social and ceremonial (FSC) fisheries.
- On August 19 Canada requested that the next Panel meeting be moved one day early to Monday, August 22. During the August 22 Panel meeting, the PSC staff reported that there was

a significant drop in test fishery catches in Johnstone Strait as well as in-river at both Cottonwood and Whonnock, with considerably lower levels of escapement than predicted for the last 6 days. As a result of this drop in abundance, PSC staff recommended run size reductions for Summer run from 4,400,000 to 3,500,000 and for Late run from 2,000,000 to 1,200,000. The reduction in the run sizes for Summer run and Late run Sockeye aligned with the concerns that Canada had expressed during the August 18 Panel meeting, prior to the U.S. approving the PSC staff run size recommendations and proposing fisheries.

- Based on the reduced run sizes and preliminary catch from the U.S. fisheries over the weekend, the U.S. was now in a position where they were over on Early Summers by 13,480, under on Summers by 102,210 and over on Lates by 75,350, with a total balance of 13,340 remaining. Catches in the U.S. fisheries during the weekend were still preliminary and expected to increase by some amount. Despite this outcome the U.S. is not in a payback situation as Paragraph 8 (c) (iv) indicates that the U.S. is only accountable if they exceed the allocations resulting from the run sizes on August 18, which the U.S. was not.
- In order to meet the Panel's bilaterally agreed upon conservation objectives for the different run timing groups, at these reduced run sizes and available TAC, the U.S. harvest of 75,350 over their share of Lates left Canada with an estimated 21,628 Late run Sockeye remaining to prosecute First Nations FSC fisheries of approximately 700,000 Sockeye and eliminated any commercial or recreational opportunities that were being considered during the following two weeks. In addition, this resulted in the Panel deciding to defer retention of test fishery pay fish which was planned to start in the coming days.
- During the August 26 Panel meeting, the PSC staff recommended a run size increase for Late run Sockeye to 1,600,000 that both countries agreed to while Early Summer and Summer run Sockeye remained at 600,000 and 3,500,000, respectively. Updated U.S. catches from the fisheries resulting from the August 18 Panel meeting increased considerably, with the U.S. over on Early Summers by 16,580 and over on Lates by 103,930, with the total U.S. harvest over by 58,730 Sockeye. This outcome further exacerbated Canada's ability to plan for First Nations FSC fisheries to harvest their fish requirements and again delayed the startup of pay fish retention.
- During the August 30 Panel meeting there were no recommendations for run size increases made by the PSC staff.
- During the September 2 meeting of the Fraser Panel, PSC staff recommended run size increases for Summer run from 3,500,000 to 3,700,000 and Late run from 1,600,000 to 1,850,000, which was the mid-point between the two Late run modelled estimates of 1,687,000 and 2,015,000. Both countries accepted the recommended increase in run size for Summer runs but not the recommended increase to Lates due to uncertainty in the assessment and concerns regarding a recent increase in Late run fish entering the river earlier than expected.
- In the September 6 Fraser Panel meeting the Panel adopted a run size of 1,850,000 Late Run sockeye. At these run sizes, the U.S. remained over on Early Summer run by 16,600 and Lates run by 63,110, with the total harvest over by 48,890. Canada was now in a position that very restricted commercial and recreational fisheries could be considered two weeks later than originally planned, and at much lower levels of harvest than would have been the case if the U.S. had supported Canada's recommended approach during the August 18 Panel meeting.

In summary, in Canada's view the August 18 run size recommendations and fishing decisions adopted by the U.S. were not consistent with the information available at that time, and concerns expressed by

Canada both during the Panel meeting, as well as in the chair to chair discussions, were not adequately considered by the U.S. As a result, Canada could not support the PSC run size recommendations or the U.S. fishery proposals. Canada is on record, during the Panel meetings requesting a delay to fisheries planning and run size recommendations, expressing concern with the uncertainty in the information and recommended run sizes more in line with what the information was suggesting. The impact of the U.S. decisions has had serious consequences on Canadian First Nations FSC and economic fisheries, as well as commercial and recreational fisheries, and resulted in no test fishery pay fish being retained in 2022.

The Treaty embodies the commitment made by Canada and the United States to collaborate in the conservation and rational management of Pacific Salmon. Canada remains committed to work collaboratively with our United States partners through the Pacific Salmon Commission process.

At this time Canada is contemplating next steps as set out in Paragraph 13 of Chapter 4 in the Pacific Salmon Treaty.

Sincerely,

Les Jantz (Canadian co-chair)

Matt Mortimer (Canadian alternate co-chair)

A handwritten signature in black ink, appearing to read 'Les Jantz', written in a cursive style.

**DRAFT AGENDA
PACIFIC SALMON COMMISSION
FRASER RIVER PANEL
Thursday August 18, 2022 at 1:00 pm.
via Zoom Webinar**

- 1) Roll Call (Panel and Tech members, others please email Julie, ehrmantraut@psc.org)
- 2) Webinar Etiquette:
 - a) Mute Phone: Please mute phone unless you are asking a question
 - b) Chat feature: Please use for questions regarding the distribution only
- 3) Agenda
- 4) Run status of Fraser River sockeye salmon relative to forecasts and adopted run sizes PSC Staff
- 5) In-season data flow for updating objectives PSC staff
 - a) Test fishing catches and acoustics
 - b) Stock proportions
 - c) Environmental conditions
 - d) Big Bar update DFO/PSC staff
- 6) Assessments and Recommendations PSC Staff
 - a) Migration graphs, escapement projections, run size assessments
 - b) Criteria for fisheries decision table
- 7) Review any decisions on staff recommendations (abundance, timing, management adjustments) Panel
- 8) Fisheries recommendations Panel
 - a) Secretariat staff evaluation of fisheries recommendations PSC Staff
 - b) Panel decisions on fisheries recommendations Panel
- 9) Other Business Panel
 - a) Pay fish
 - b) Weekly Report No. 6 (confirm reviewers)
- 10) Next FRP Meeting, Tuesday August 23, 10:30 a.m. Panel
 (Sheraton Vancouver Airport Hotel and via Zoom Webinar)
 Next Technical Committee meeting, Thursday August 25, 1:00 p.m. via Zoom TC

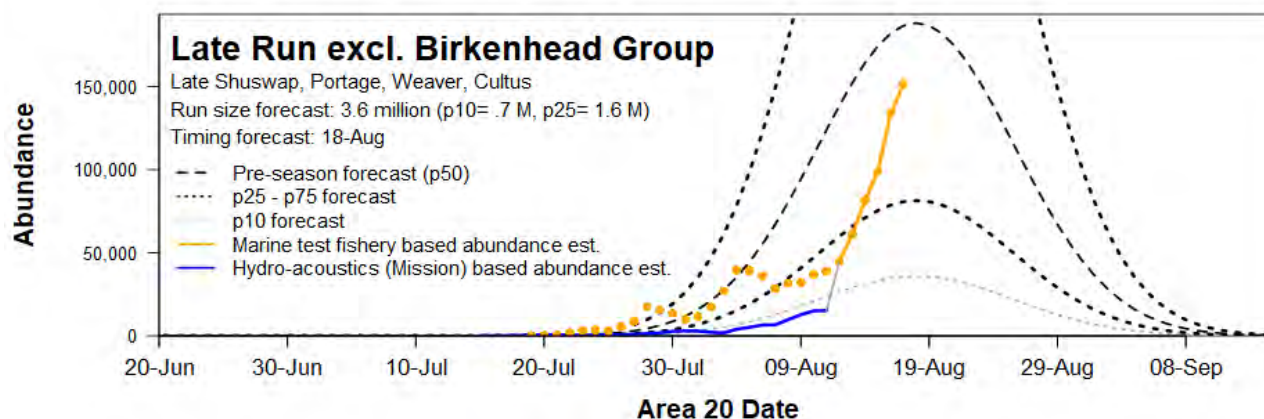
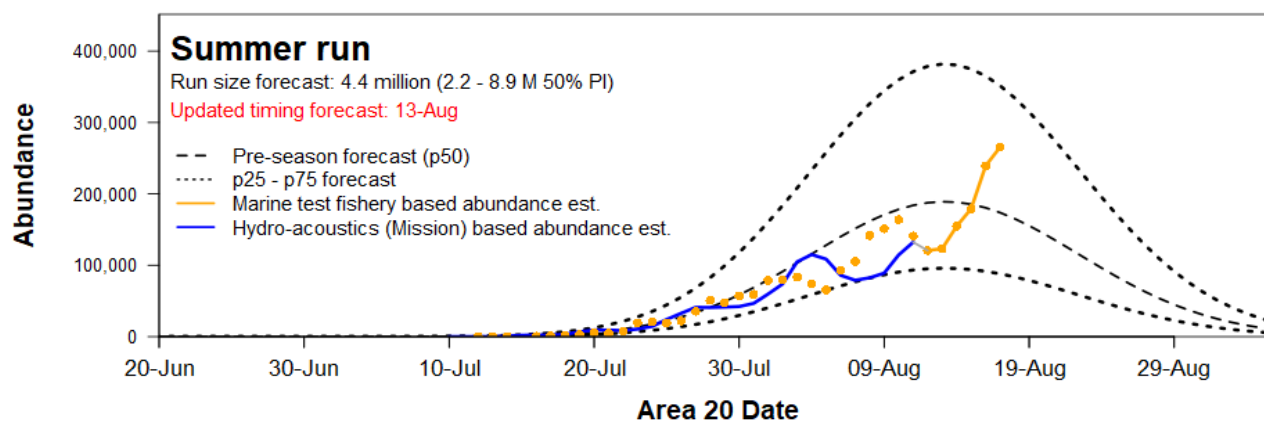
2022 Run status of Fraser sockeye salmon

Date: Aug. 18, 2022

The information presented in this distribution has been prepared by PSC Secretariat staff and should be considered preliminary until reviewed by the Fraser River Panel

Week of: Aug. 14 - Aug. 20, 2022	Sockeye				
	Management Group				Total Fraser
	E.Stuart	E.Summer	Summer	Late	
Mission passage (inclds Pitt, Alouette, Coquitlam)	243,300	494,500	1,259,600	98,700	2,096,100
Catch downstream of Mission	900	32,700	228,500	94,800	356,900
Accounted Run To Date	244,200	527,200	1,488,100	193,500	2,453,000
Run size adopted in-season ²	244,000	614,000	na	na	na
Run size forecasted pre-season	105,000	1,579,000	4,403,000	3,688,000	9,775,000
Area 20 timing adopted in-season	6-Jul	30-Jul	na	na	na
Area 20 timing expected pre-season	4-Jul	6-Aug	10-Aug	18-Aug	13-Aug
Johnstone Str. Diversion Rate	In-season 5-day average				65%
	Preseason forecast of annual rate:				48%

² Run sizes are usually not adopted until after the peak of the run has passed through marine test fishery areas in Juan de Fuca and Johnstone straits.



2022 Catch-to-date by fishery

Date: Aug. 18, 2022

Week of: Aug. 14 - Aug. 20, 2022		Sockeye	
		Total	Fraser
Canada		292,720	292,039
	Commercial	0	0
	B Purse Seine	0	0
	D Gillnet	0	0
	E Gillnet	0	0
	G Troll	0	0
	H Troll	0	0
	First Nations	278,047	277,366
	Food, Social & Ceremonial (FSC)	278,047	277,366
	Marine	154,632	153,951
	Fraser R.	123,415	123,415
	Economic Opportunity (EO) & Demonstration (Demo)	0	0
	Escapement Surplus to Spawning Requirements (ESSR)	0	0
	Recreational	0	0
	Charter (Albion & A12 Chum test fishery)	207	207
	Other****	14,466	14,466
United States		139,581	139,297
	Commercial	128,092	127,961
	Treaty Tribes (TRB)	122,742	122,611
	All Citizen (AC)	5,350	5,350
	Treaty Tribes Ceremonial & Subsistence (C&S)	11,489	11,337
	All Citizen Recreational	0	0
	Other****	0	0
	Alaska *	na	na
Panel-approved Test Fisheries		26,849	26,437
	Panel Waters	17,676	17,449
	Canada	17,563	17,338
	U.S.	113	110
	Non-Panel Waters**	9,173	8,988
Total		459,150	457,772
Catch Seaward of Mission ***		358,354	356,976
Catch Upstream of Mission		100,796	100,796

* Alaska data are processed post-season and so are unavailable in-season.

** Includes Qualark

*** All catches in marine areas and in the Fraser River downstream of Mission.

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

		Fraser Sockeye					
		Early Stuart	Early Summer	Summer	Lates	Total	
RUN STATUS, ESCAPEMENT NEEDS & AVAILABLE SURPLUS							
Pre-season or Adopted In-season Run Size		244,000	614,000	4,403,000	3,688,000	8,949,000	
Adult Spawning Escapement Target (SET)		219,600	375,500	2,201,500	1,844,000	4,640,600	
%SET from TAM rules		90%	61%	50%	50%		
Management Adjustment (MA)*		2,918,480	221,550	88,060	405,680	3,633,770	
Proportional MA (pMA)*		13.29	0.59	0.04	0.22		
Adjusted Spawning Escapement Target (SET) **		244,000	597,050	2,289,560	2,249,680	5,380,290	
Test Fishing (TF)*****		1,050	9,390	49,890	37,170	97,500	
Surplus above Adjusted SET & Test fishing		0	7,560	2,063,550	1,401,150	3,472,260	
DEDUCTIONS & TAC FOR INTERNATIONAL SHARING							
Aboriginal Fishery Exemption (AFE)		0	82,059	169,691	148,250	400,000	
Total Deductions (Adj. SET + TF + Available AFE)		245,050	688,499	2,509,141	2,435,100	5,877,790	
Available TAC for International Sharing		0	0	1,893,859	1,252,900	3,146,759	
UNITED STATES (Washington) TAC							
Proportionally Distributed TAC ***		16.5%	0	0	312,490	206,730	519,220
U.S. Payback ***		0.0%	0	0	-280	-190	-470
Proportionally Distributed TAC + Payback		0	0	312,210	206,540	518,750	
Treaty Tribes Share ***		67.7%	0	0	211,280	139,770	351,050
All Citizen Share		32.3%	0	0	100,930	66,770	167,700
CANADA TAC							
Aboriginal Fishery Exemption (AFE)		0	82,059	169,691	148,250	400,000	
Canadian TAC + AFE		0	82,059	1,751,340	1,194,610	3,028,009	
CATCH-TO-DATE							
Test		1,080	6,220	15,400	3,740	26,440	
Treaty Tribes (Wash.) / Ceremonial (TRB)		0	12,440	81,850	39,650	133,950	
All Citizen (Wash.)		0	370	3,420	1,570	5,350	
Other (Wash.)****		0	0	0	0	0	
Washington		0	12,810	85,270	41,220	139,300	
First Nations Catch (including AFE)		1,540	34,400	189,910	51,520	277,370	
Planned Charter & Recreational Shares		10	50	130	12	207	
Other****		1,270	5,620	7,500	70	14,470	
Total Commercial (including FN EO/Demo*****)		0	0	0	0	0	
Canada		2,820	40,070	197,540	51,602	292,040	
Total Catch in All Fisheries		3,900	59,100	298,210	96,562	457,770	
Exploitation Rate (catch-to-date / run size)		1.6%	9.6%	6.8%	2.6%	5.1%	
Exploit. Rate with fishery-induced mortality included		1.6%	9.6%	6.8%	2.6%	5.1%	
CATCH REMAINING (BALANCE)							
Washington		0	-12,810	226,940	165,320	379,450	
Canada		-2,820	41,989	1,553,800	1,143,008	2,735,977	
Balance Remaining [below share / -above share]		-2,820	29,179	1,780,740	1,308,328	3,115,427	

* Given the 2022 pre-season forecasts of abundances, fisheries decisions that could impact the Early Stuart sockeye management group will be based on Low Abundance Exploitation Rate (LAER) limit of 10%.
The intent of LAER is to allow for limited fisheries directed on co-migrating stocks or species, but also may permit limited harvest in some cases. The application of the LAER obviates the need for management adjustments for this group.

** The adjusted SET is the lesser of the run size or the sum of the MA + TAM - defined SET.

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

Sockeye: 16.5% of the TAC - payback (maximum of 5% of share).

Pink: 25.7% of the TAC - payback (maximum of 5% of share)

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

***** EO = FN Economic Opportunity fisheries; Demo = FN Demonstration fisheries.

***** The test fishing deduction was updated in-season to 97,500 on August 18, 2022

2022 Fraser Sockeye Test Fishing & Escapement Summary

Area/Gear Location From A20	Johnstone Strait				Juan de Fuca Strait		Fraser River									
	A12 GN		A12 PS	A13 PS	A20 GN*	A20 PS	A29-13 GN	A29-17 GN	A29-16 GN	Whon CPUE	Qualark			Mission Hydroacoustics		Hells Gate
	Round Is (-2 days)	Round Is Alaska Twist	Blinkhorn (-1 day)	Lower JS (+1 day)	Port Renfrew (0 days)	Port Renfrew (0 days)	Cottonwood (+5 days)	Brownsville Bar ³	Whonnock (+6 days)	Estimate (+6 days)	GN Catch (+8 days)	Estimate ⁴	Method ⁵	Estimate ⁶ (+6 days)	Method ⁷	Estimates ⁸ (+10 days)
28-Jul	42	34	331	445	125	1,304	24	89	20	1.74	128	51,880	RB x 2	19,800	A1+M+A2proj	No Count
29-Jul	38	34	373	725	30	2,678	38	164	32	2.72	107	51,738	RB x 2	25,500	A1+M+A2	20,220
30-Jul	17	42	90	667	120	394	67	71	43	3.49	114	36,106	RB x 2	31,500	A1+M+A2	No Count
31-Jul	36	30	282	734	382	340	57	242	63	5.18	114	37,100	RB x 2	37,900	A1+M+A2	No Count
1-Aug	16	48	0 (1 set)	354 (3 sets)	118	1,705	53	195	29	2.32	92	47,937	RB x 2	65,500	A1+M+A2	21,080
2-Aug	1	5	1,516	309	441	773	23	257	47	3.21	125	52,566	RB x 2	63,200	A1+M+A2	16,940
3-Aug	2	11	165	262 (5 sets)	317	409 (2 sets)	Did not fish	212	58	4.38	124	54,892	RB x 2	62,600	A1+M+A2	22,820
4-Aug	16	8	706	507	436	2,186	31	132**	32	2.84	91	32,522	RB x 2	52,300	A1+M+A2	50,650
5-Aug	1	1	434	105	142	1,827	54	200	50	4.08	89	41,753	RB x 2	56,600	A1+M+A2	No Count
6-Aug	20	28	688	327 (4 sets)	Did not fish	598	28	43	50	4.02	99	40,980	RB x 2	61,600	A1+M+A2	No Count
7-Aug	4	23	11	149 (5 sets)	31	675 (2 sets)	161	119	37	3.22	63	67,355	RB + LB	49,300	A1+M+A2***	No Count
8-Aug	21	25 (1 set)	996	1101 (5 sets)	271	1,500	87	177	28	2.44	73	63,274	RB + LB	105,700	A1+S1+M+A2	48,630
9-Aug	55	81	840	989	443	1,588	190	359	37	3.25	77	64,535	RB + LB	109,100	A1+S1+M+A2	No Count
10-Aug	26	38	2,683	667	49	3,026	113	222	71	5.87	85	85,880	RB + LB	183,300	A1+S1+M+A2	87,120
11-Aug	27	62	769 (4 sets)	984	149	2,360	176	218	61	4.86	140	77,041	RB + LB	146,500	A1+S1+M+A2	45,050
12-Aug	11	24	5,147	809	394	2,151	93	149	45	3.76	122	98,146	RB + LB	85,400	A1+S1+M+A2	77,820
13-Aug	28	94	6,632	1,187	19	1,259	59	149	48	4.06	149	138,310	RB + LB	70,000	A1+S1+M+A2***	No Count
14-Aug	2	14	8,354	3,036	97	1,845	38	121	56	4.87	143	108,354	RB + LB	86,200	A1+S1+M+A2	No Count
15-Aug	End	End	9,901	254	8	1,459	105	139	11	1.00	116	115,372	RB + LB	56,200	A1+S1+M+A2	No Count
16-Aug			11,520	1,274	5	1,202	289	223	12	1.09	150	92,953	RB + LB	90,700	A1+S1+M+A2	111,450
17-Aug			8,145	2,756	End	3,020	148	407	17	1.57	64	66,961	RB + LB	186,500	A1+S1+M+A2	110,550
18-Aug																
19-Aug																

¹ Alaska Twist - Southern Endowment Fund Project

A four-year (2019-2022) study to compare the relative catchability of Fraser River Sockeye in the Round Island gill net test fishery using a MS60 versus an AT90 gill net. The objectives of this study will be to compare the trends in selectivity, catchability and catch composition by set for the AT90 and MS60 nets. The use of the Alaska Twist is strictly experimental and cannot be used to inform assessment of abundances through the Johnstone Strait at this time.

² Reefnet counts are the sum of two gears/sites

³ Alternative Lower River Test Fishery - Southern Endowment Fund Project

A four-year (2021-2024) study to evaluate an alternative location for the Cottonwood test fishery in the lower Fraser River.

⁴ Qualark escapement estimate - does not include Chilliwack, Pitt, Harrison, Birkenhead, Big Silver, Weaver, and Cultus

⁵ Qualark source:

RB x 2 = Right-bank (RB) x 2

RB + LB = Right-bank (RB) + Left-bank (LB)

⁶ Mission escapement estimate - does not include Pitt

⁷ Mission source:

A1+M+A2proj = Left-bank ARIS (A1) + Mobile split-beam (M) + Right-bank ARIS projection (A2proj)

A1+M+A2 = Left-bank ARIS (A1) + Mobile split-beam (M) + Right-bank ARIS (A2)

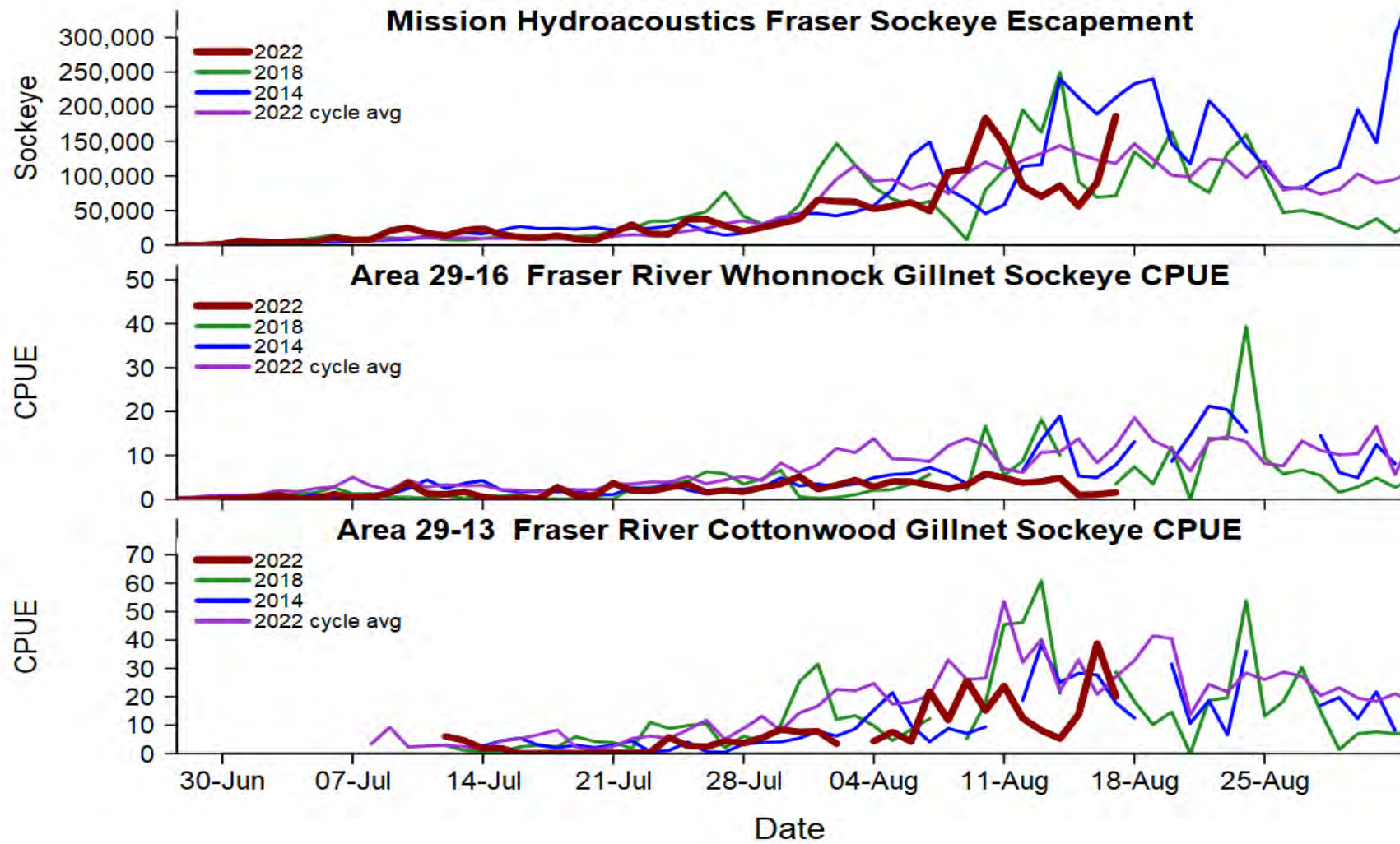
A1+S1+M+A2 = Left bank ARIS (A1) + Left bank split-beam (S1) + Mobile split-beam (M) + Right bank ARIS (A2)

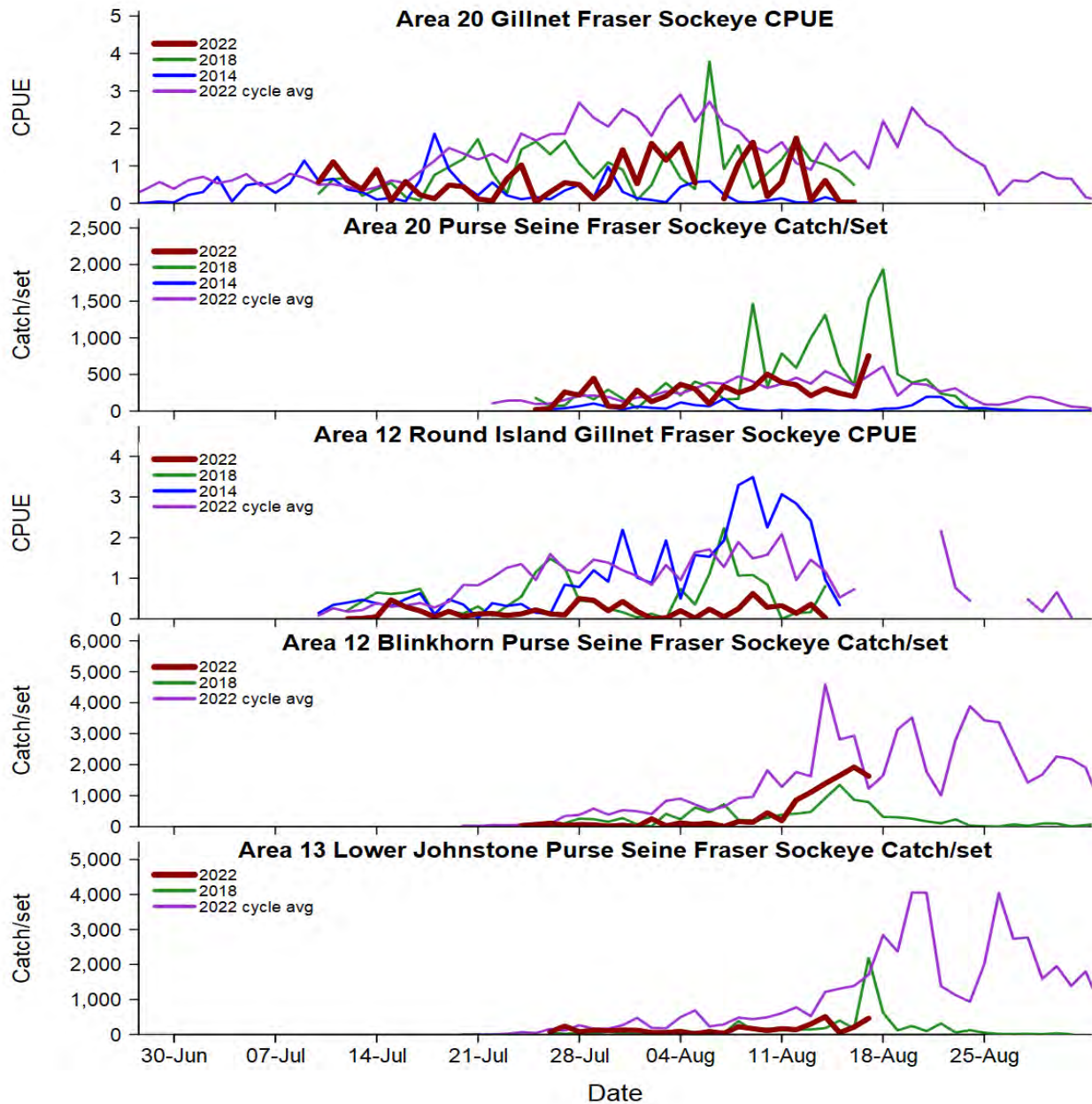
⁸ Daily Hells Gate abundance estimate; actual daily count has been expanded.

* Area 20 Gillnet - two boats fishing each day, unless specified otherwise

** Beginning August 4th, reduced effort was employed when sample sizes sufficient for stock identification purposes were collected in the first set

***Fishery occurred at Mission site





Fraser Sockeye: Qualark Passage Estimate and Mission-based Projection

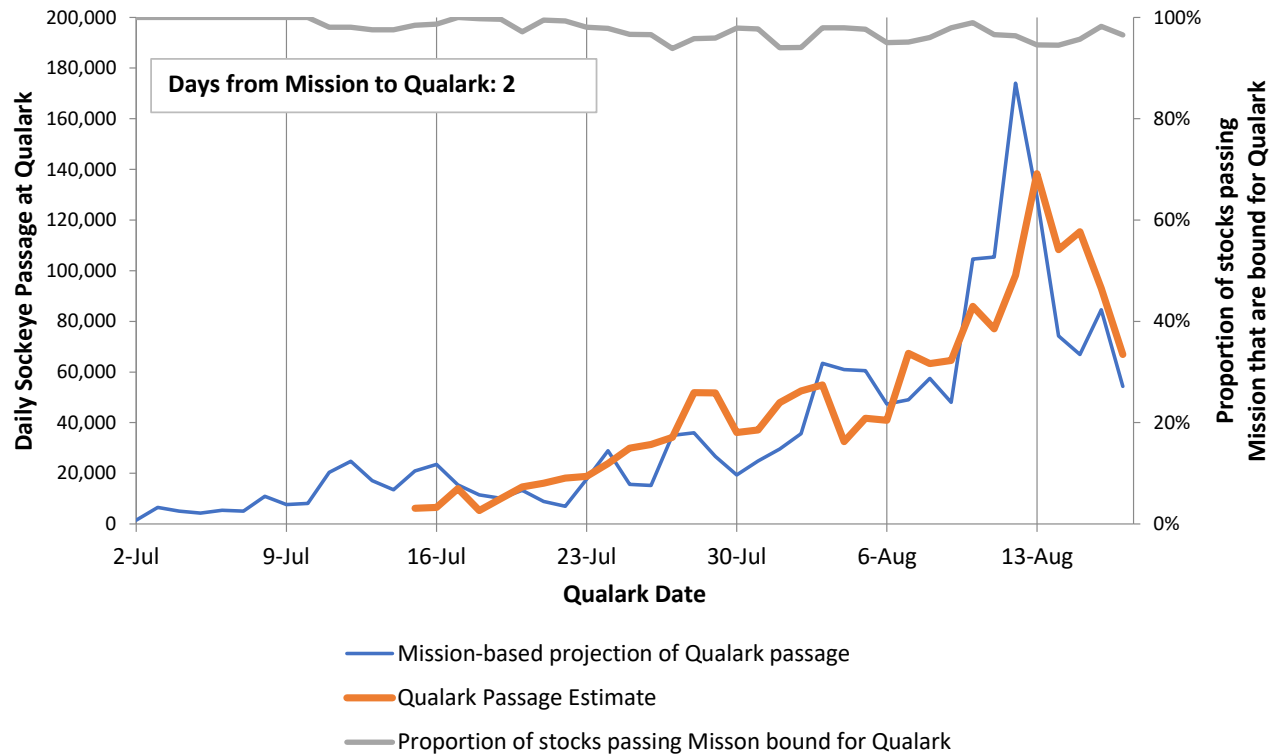
Year: **2022**

Date: 18-Aug-22

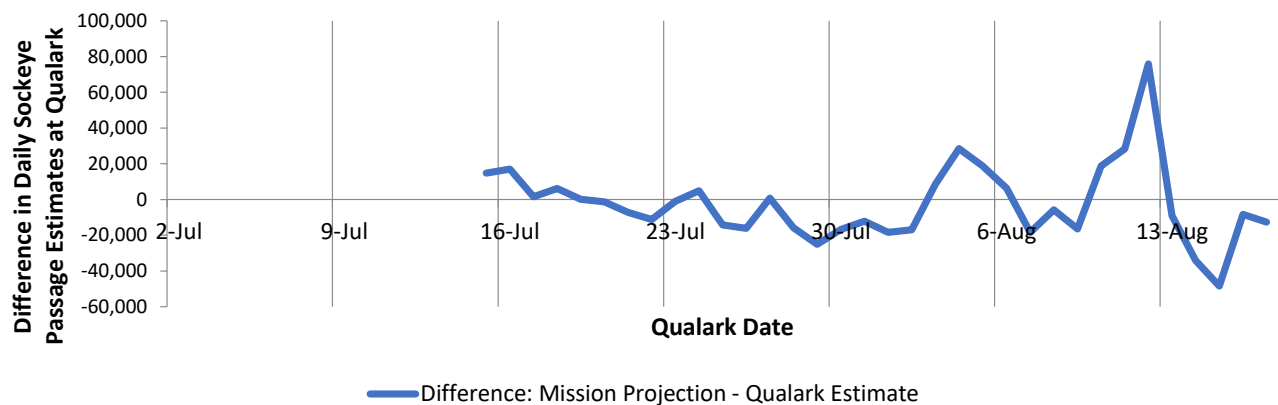
Time: 11:08 AM

	All Days	Common Days
Mission projection	1,973,482	1,575,164
Qualark estimate	1,654,569	1,654,569
	Difference	-79,404
	%Difference	(5%)

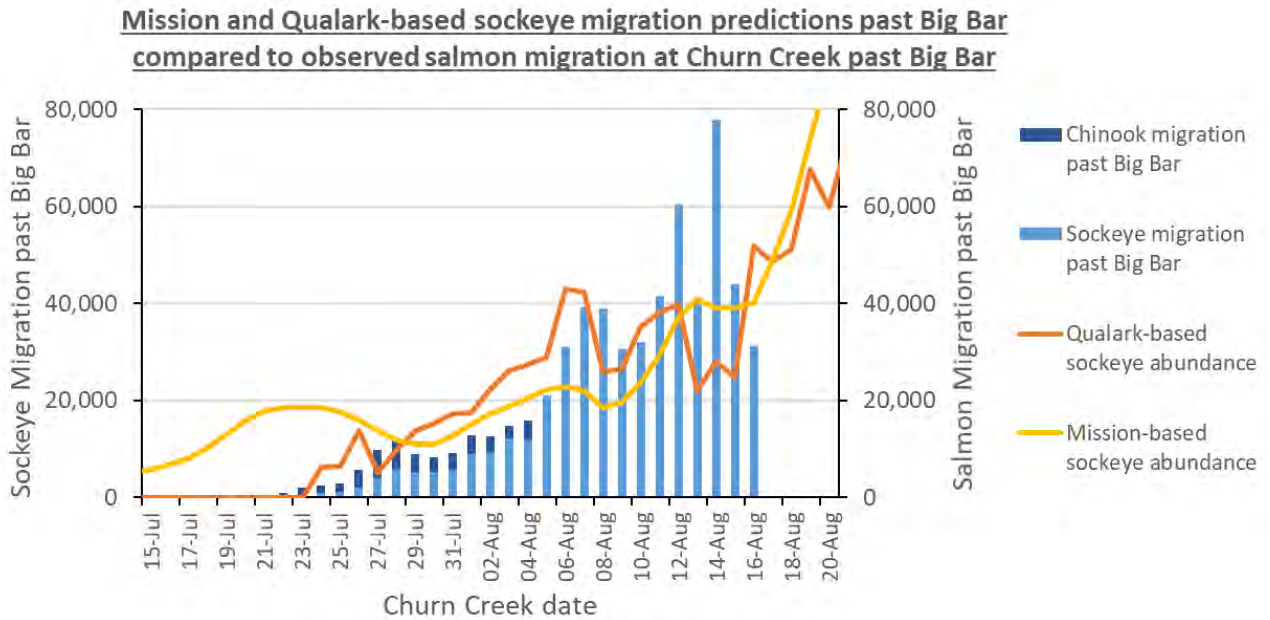
Compare Qualark Passage Estimate and Mission-based Projection



Difference between Qualark Passage Estimate and Mission-based Projection

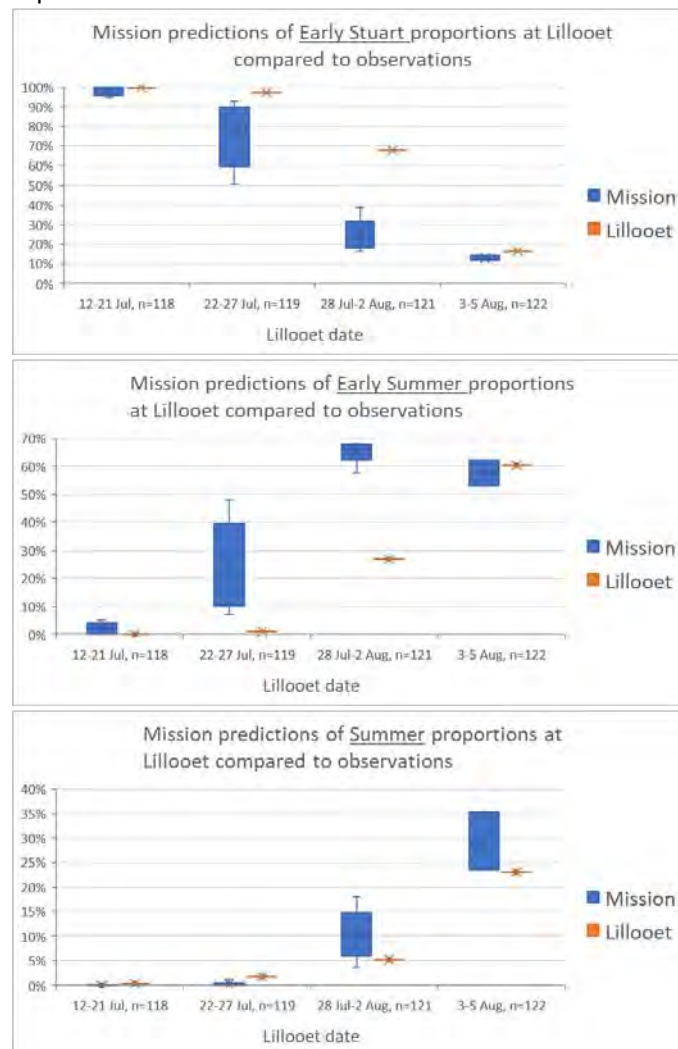


Comparisons between Mission and Qualark predictions and Big Bar estimates

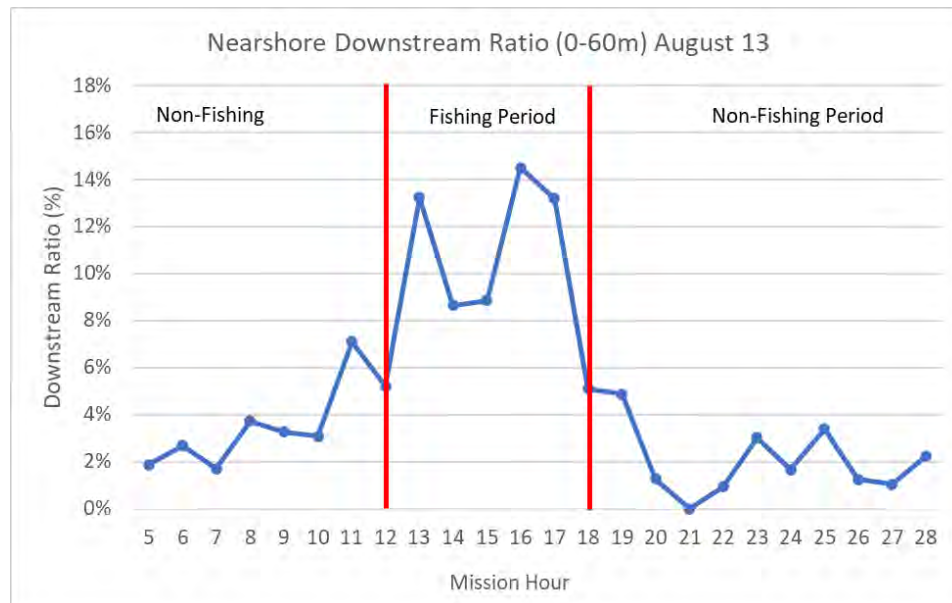


Comparisons of stock ID collected at Lillooet with Mission predictions of stock ID

- Differences in stock ID early in the season indicate salmon have been slower than normal to migrate up the Fraser River to Lillooet, especially during the period from July 11- August 2 (Lillooet date) when the proportion of Early Stuart sockeye was much higher than expected based on normal migration speeds and the proportions of Early Summer run sockeye lower (sample sizes refer to Lillooet samples).
- The impacts of slower migration speeds still seem to linger in the period from August 3 to 5 with the proportion of Summer-run sockeye being lower than expected.
- This evidence of slower migration and redistribution of stocks between Mission and Qualark/Big Bar has been hampering the comparison of daily abundance estimates between the different systems.
- Moving forward, it is anticipated that the impact of delays in migration due to high discharge would be minimal. Instead, the impact of fishing activity (both the removal of catches and changes in fish behaviour, i.e. increased downstream ratios, delays in upstream migration) could be impacting the comparison between sonar estimates.



- Comparison of Mission left-bank split-beam (0-60m) downstream ratios before, during, and after a fishery at Mission on August 13. Higher downstream ratios during the fishery indicating redistribution of fish in the river and interruption of normal migration pattern.

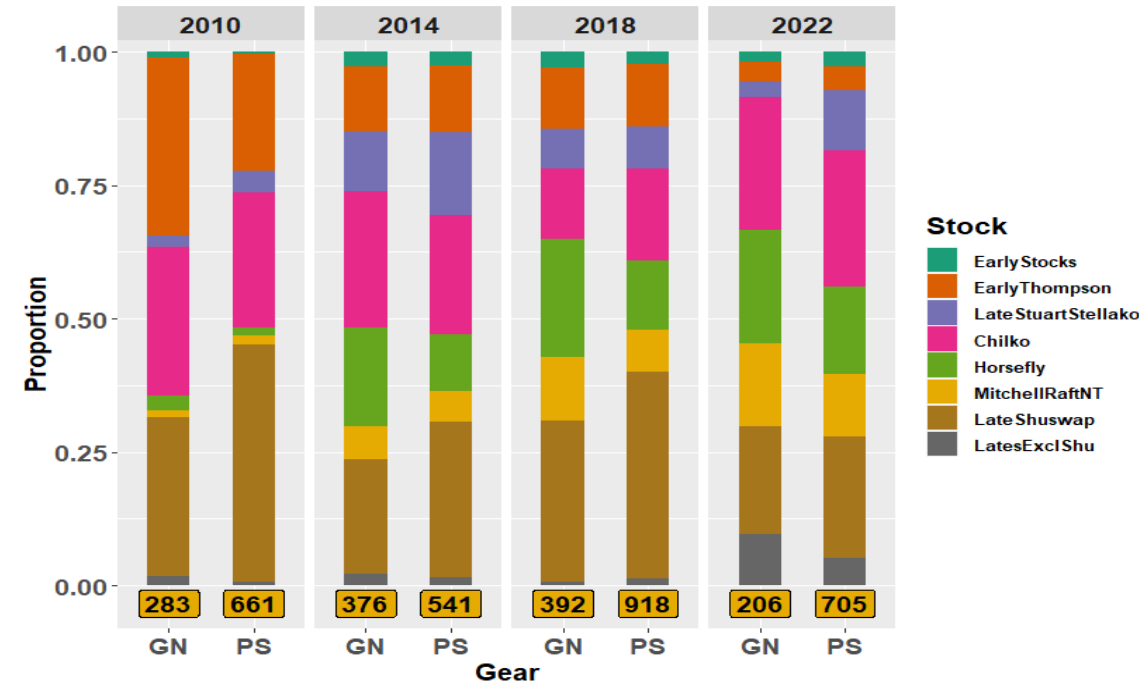


2022 Fraser River Sockeye Salmon Stock identification Review

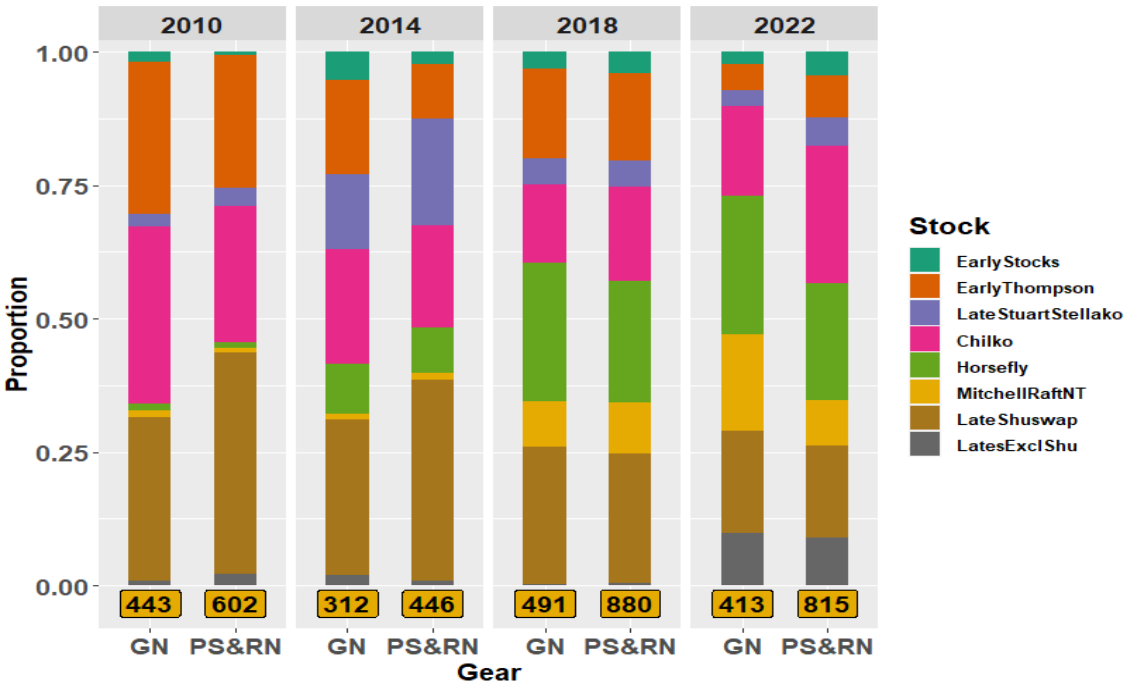
Recent stock composition estimates for sockeye salmon

Fishing						Fraser-only Stock Proportions by Reporting Group ⁴ (%)														Age (%)			
						Early Stuart	Early Summer					Summer					Late				Overall Stocks		
							Nadina Bowron																
							Pitt Alouette Nahat-latch Early Thompson					Harri-son Late Chilko Raft North Thompson					Birken-head Late Shuswap Weaver				Late sub-total		
Area/Gear ¹	Sector ²	Date	Type ³	Size (n)	%Fraser	Early Stuart	Chilli-wack	Coquit-lam	Taseko	Thomp-son	Early Summer sub-total	Widg-eon	Stuart Stellako	Chilko Ques-nel	Raft Thompson	Summer sub-total	Big Silver	Shuswap Portage	Weaver Cultus	Late sub-total	Age-4 ₂		
Johnstone Strait & Queen Charlotte Strait																							
A13 ps	tf	Aug 14	DNA	89	100%	0%			3%	3%	5%		14%	62%		76%		17%	2%	19%	NA		
A12 ps	tf	Aug 13	DNA	100	100%	0%		0%	2%	1%	3%		14%	43%	3%	59%		29%	8%	37%	98%		
A12 ps	tf	Aug 14	DNA	98	99%	0%				1%	1%		7%	59%		66%	1%	29%	3%	33%	100%		
A12 ps		Aug 20	Prediction	1	100%	0%		0%		1%	1%		6%	50%	1%	57%	0%	35%	7%	42%	NA		
Juan de Fuca Strait & Washington & Other																							
A7 ps	cm	Aug 14	DNA	89	100%	0%			2%	6%	8%	2%	3%	62%		67%	2%	19%	3%	25%	97%		
A7/7A ps	cm	Aug 14	DNA	99	100%	0%			5%	3%	8%	1%	10%	45%		56%	3%	28%	5%	36%	95%		
A20 gn	tf	Aug 14	DNA	90	99%	0%				6%	6%		3%	66%		68%	9%	11%	6%	26%	NA		
A20 ps	tf	Aug 16	DNA	100	100%	0%					0%	1%	6%	60%		66%	3%	27%	4%	34%	98%		
A20 ps		Aug 20	Prediction	1	100%	0%			0%	1%	1%	1%	6%	50%		56%	3%	32%	7%	42%	NA		
In-river																							
BB gn	tf	Aug14-15	DNA	88	100%	0%			4%	5%	9%		11%	74%		85%	1%	5%		6%	NA		
BB gn SEF	tf	Aug14-15	DNA	99	100%	0%			1%	5%	6%		19%	64%		83%	5%	6%		11%	99%		
BB gn	tf	Aug 16	DNA	50	100%	0%				8%	8%		2%	76%		77%	4%	10%		14%	NA		
BB gn SEF	tf	Aug 16	DNA	50	100%	0%			6%	6%	12%		7%	79%		86%	2%			2%	95%		

Stock proportion comparison across years in Johnstone St. for samples between Aug 05 and Aug 15



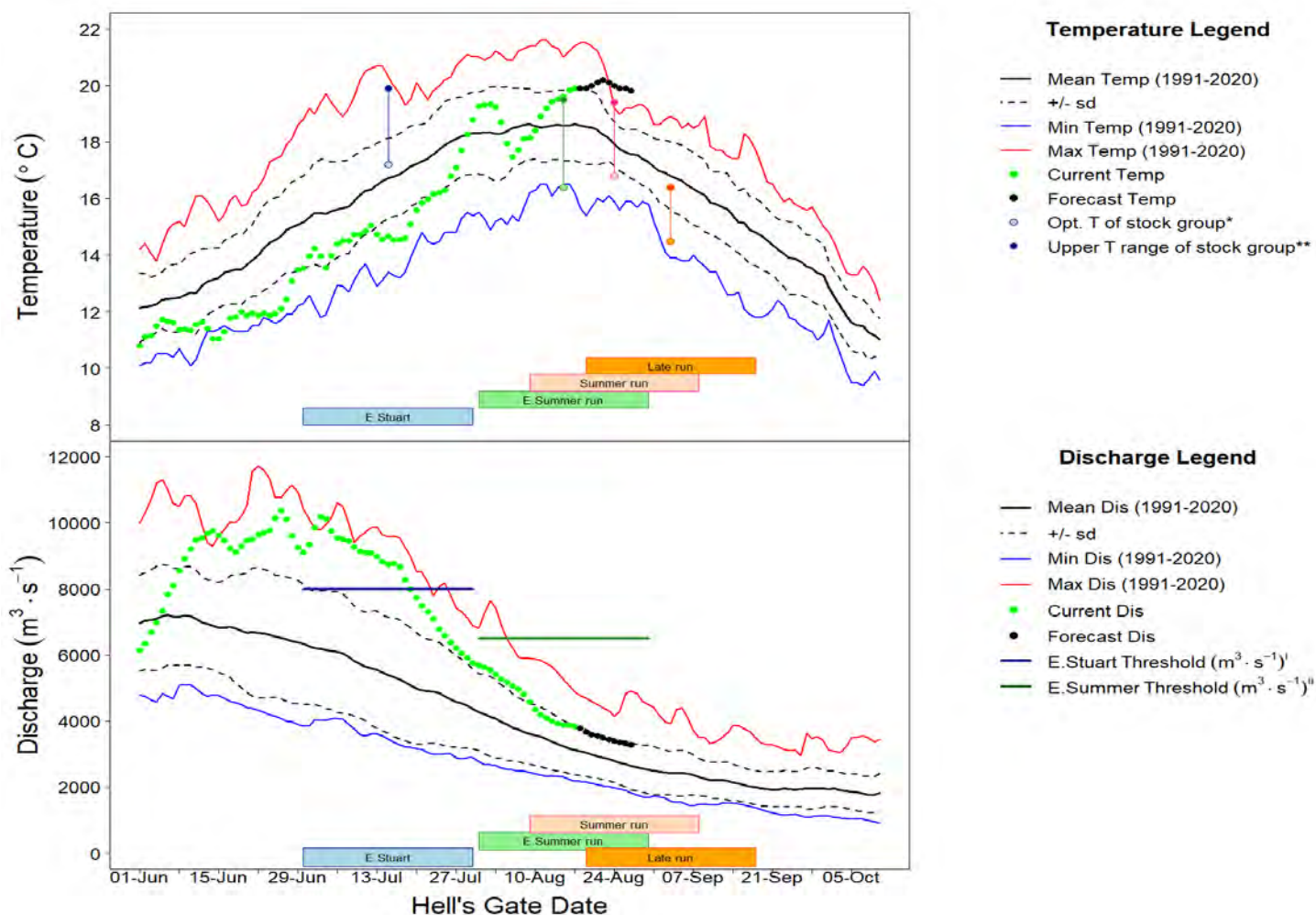
Stock proportion comparison across years in Juan de Fuca for samples between Aug 05 and Aug 15



Fraser River Environmental Report for August 17, 2022

Observed Fraser River Temperature at Qualark for 17-Aug	19.9°C
Average (1991-2020) Historical Temperature on this day	18.6°C
Deviation from Average	1.3°C
Forecast Temperature for 23-Aug-22	20.1°C
The forecast in Kamloops and Prince George is for above average air temperatures for the period (>5 degrees above historic averages (1981-2010)).	

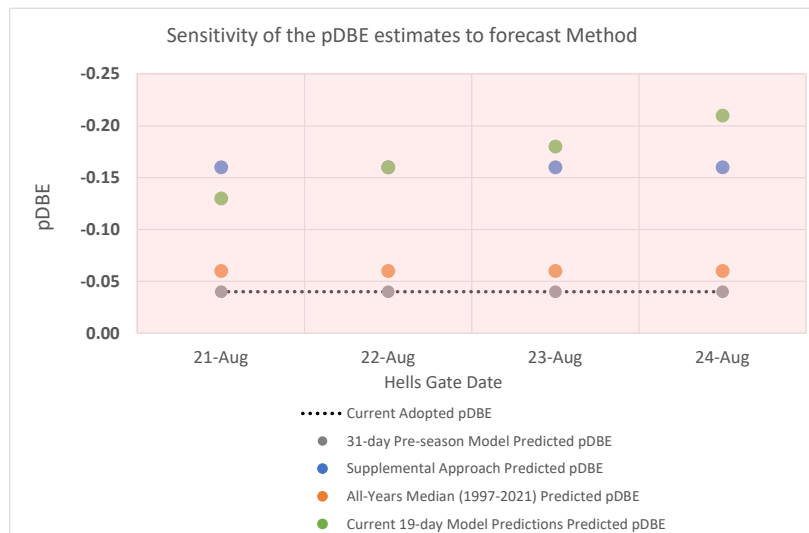
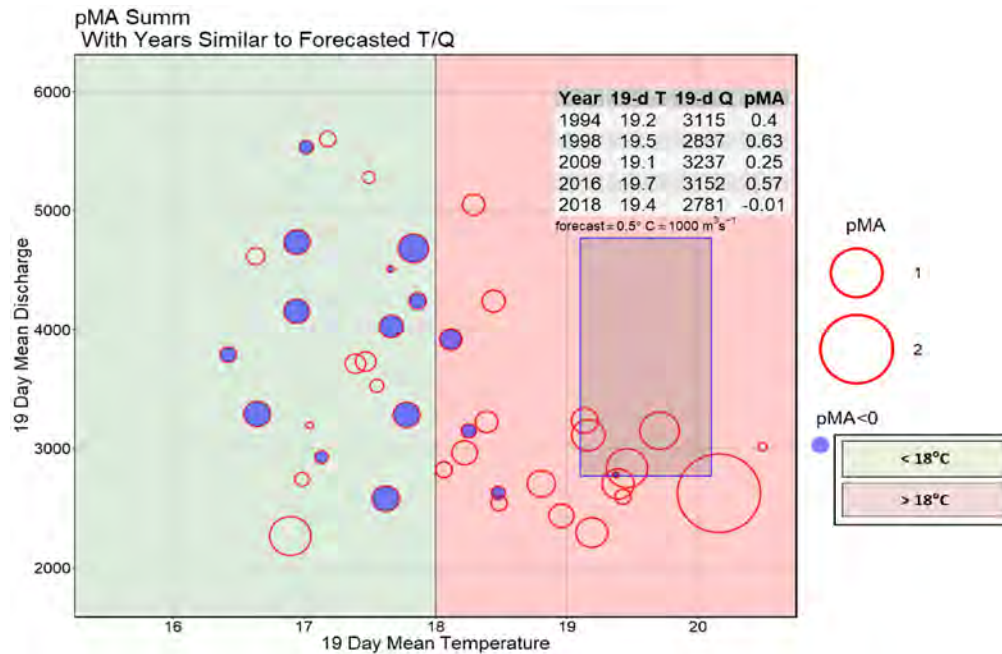
Observed Fraser River Discharge at Hope for 17-Aug	3836 m ³ ·s ⁻¹
Average (1991-2020) Historical Discharge on this day	3119 m ³ ·s ⁻¹
% above or below Historical Discharge	23%
Forecast Discharge for 23-Aug-22	3444 m ³ ·s ⁻¹
The forecast in Kamloops is for some precipitation (14 mm) and minimal precipitation in Prince George (4 mm)	



Run timing bars represent a 31 day spread of the run centered around the Hell's Gate date. Hell's gate timing is 5 days from Mission for Early Stuart and Late run; and 4 days from Mission for Early Summer and Summer run. ⁱpMA is the proportional increase to spawning escapement targets to help ensure targets are achieved. ⁱⁱ%DBE is %difference between estimates of potential spawning escapement and spawning escapement. *This is the optimum temp for aerobic swimming - T_{opt} (Eliason et al. (2011). Science 332: 109-112)**This is the upper range of the optimum temp for aerobic swimming - T_{pejus}. ⁱDischarge threshold of 8000cms for Early Stuart from Macdonald (2000). Can. Tech. Rep. Fish. Aquat. Sci. 2315: 120p. ⁱⁱDischarge threshold of 6500cms for Early Summer run from Macdonald et al. (2010). Trans. Am. Fish. Soc. 139: 768-782. 19 days of T & Q data are required to calculate a pMA - 15 days before the Hell's Gate Date and 3 days after. MA estimates can be calculated 4 days after the Area 20 date.

Summer run pDBE Forecast and Sensitivity Analysis for August 18, 2022

Based on the retrospective analysis evaluation of 2010-2021 for Summer run the best performing in-season model is the 31-day pre-season model



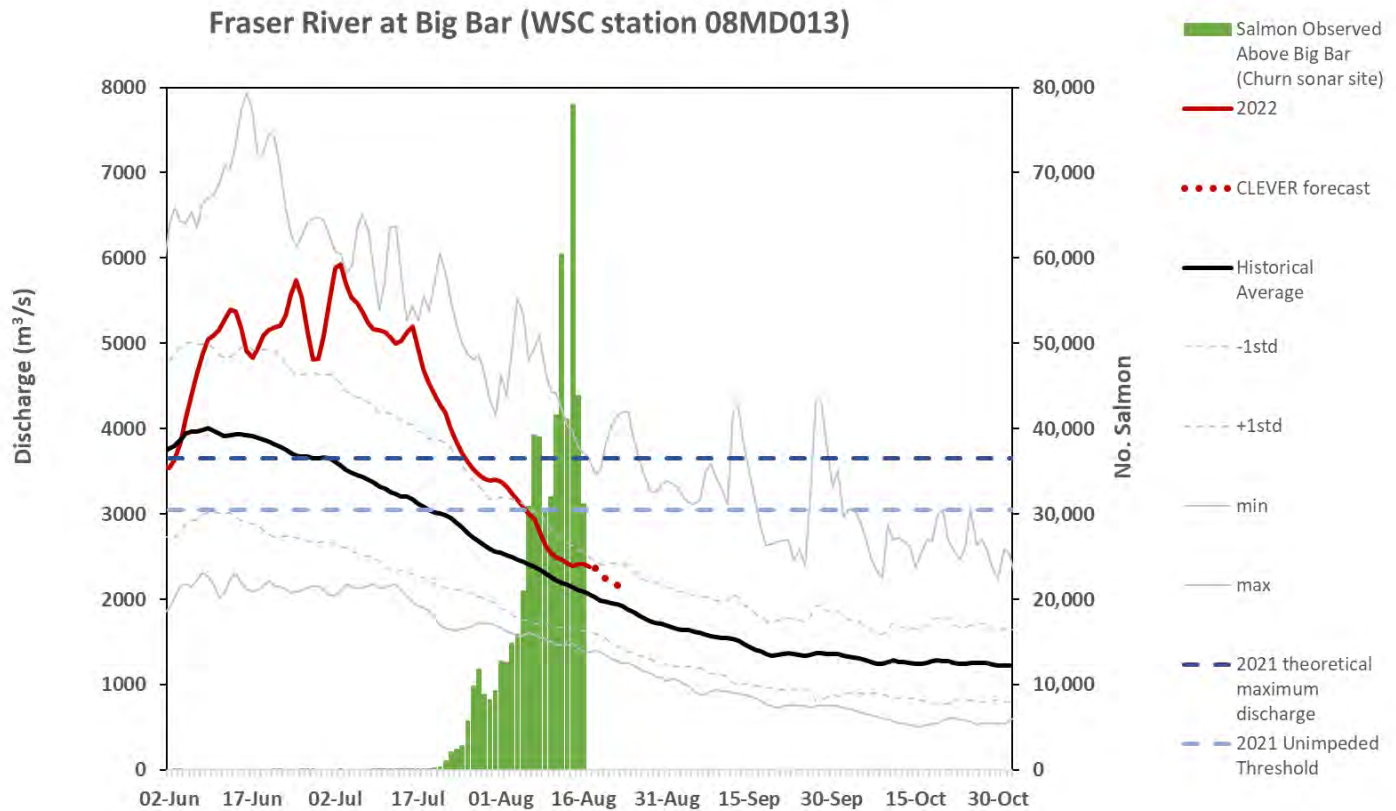
Model Performance Based on "In-season pDBE Approach" Retrospective					Best		Tied Second Best (too conservative)	Tied Second Best (not conservative enough)	Least
					Current Adopted	31-day Pre-season Model	Supplemental Approach	All-Years Median (1997-2021)	Current 19-day Model Predictions
Area	Hells Gate	Average	Average						
20 Date	Date	Temperature °C	Discharge m³/s	pDBE	Predicted pDBE	Predicted pDBE	Predicted pDBE	Predicted pDBE	Predicted pDBE
10-Aug	21-Aug	19.3	4027	-0.04	-0.04	-0.16	-0.06	-0.13	
11-Aug	22-Aug	19.4	3937	-0.04	-0.04	-0.16	-0.06	-0.16	
12-Aug	23-Aug	19.5	3851	-0.04	-0.04	-0.16	-0.06	-0.18	
* 13-Aug	24-Aug	19.6	3769	-0.04	-0.04	-0.16	-0.06	-0.21	
Implied pMA									
* 13-Aug	24-Aug	19.6	3769	0.04	0.04	0.19	0.06	0.27	

* Currently adopted timing with updated forecast information (9 observed and 10 forecast days)

Current Temperatures						
Upriver of Slide	Map #	17-Aug	Daily Mean	Historic Mean	Deviation from Historical Mean	Historic Year Range
<u>Fraser River Mainstem</u>						
	1	Fraser River @ Qualark	19.9	18.6	1.3	1991-2020
	2	Fraser River @ Texas Creek	19.5	18.2	1.3	2006-2021
	3	Fraser River @ Big Bar Creek	19.3	NA	NA	2019-2021
►	4	Fraser River @ Marguerite	19.0	17.8	1.2	2015-2021
►	5	Upper Fraser @ Shelley	15.5	15.3	0.2	1994-2021
<u>Fraser River Tributaries</u>						
	6	Thompson R. @ Ashcroft	19.2	18.6	0.6	1995-2021
	7	South Thompson @ Chase	20.1	19.6	0.5	1994-2021
	8	North Thompson @ McLure	16.9	15.6	1.3	2006-2021
►	9	Quesnel R. @ Quesnel	17.9	17.4	0.5	2000-2021
►	10	Nechako R. @ Isle Pierre	19.7	18.9	0.8	2006-2021
►	11	Stuart R. @ Ft. St. James	20.1	18.5	1.6	2000-2021



Fraser River Discharge at Big Bar



Data made available by:  Environment and Climate Change Canada and  northwest hydraulic consultants

Migration passage at Big Bar

<https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/fish/aquatic-habitat-management/fish-passage/big-bar-landslide-incident?keyword=big&keyword=bar>

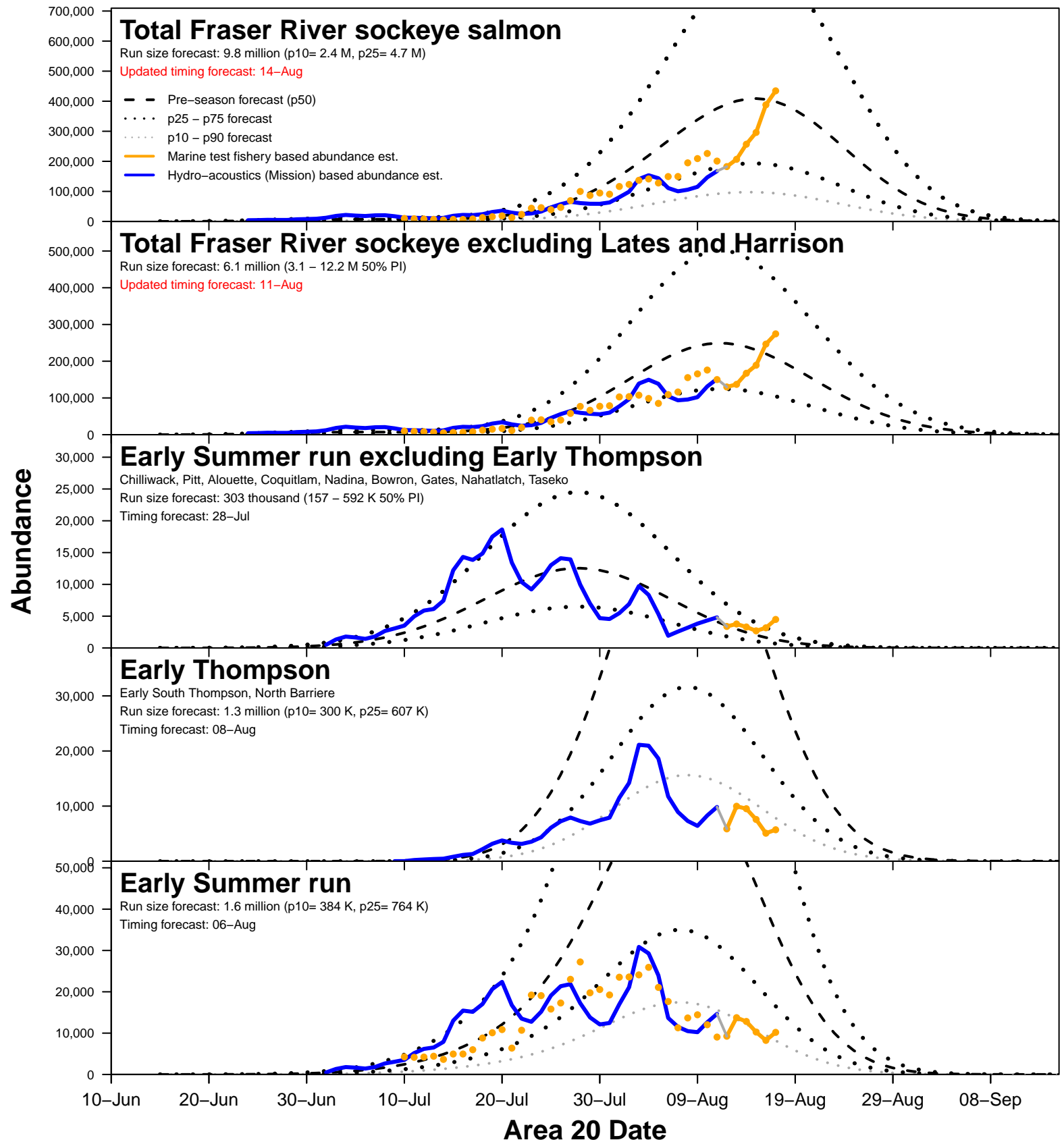
<https://www.pac.dfo-mpo.gc.ca/pacific-smon-pacifique/big-bar-landslide-eboulement/smon-count-denombrement-eng.html>

Big Bar Update

- A total of 562,436 sockeye have been observed 40km upstream of Big Bar (Churn Creek).

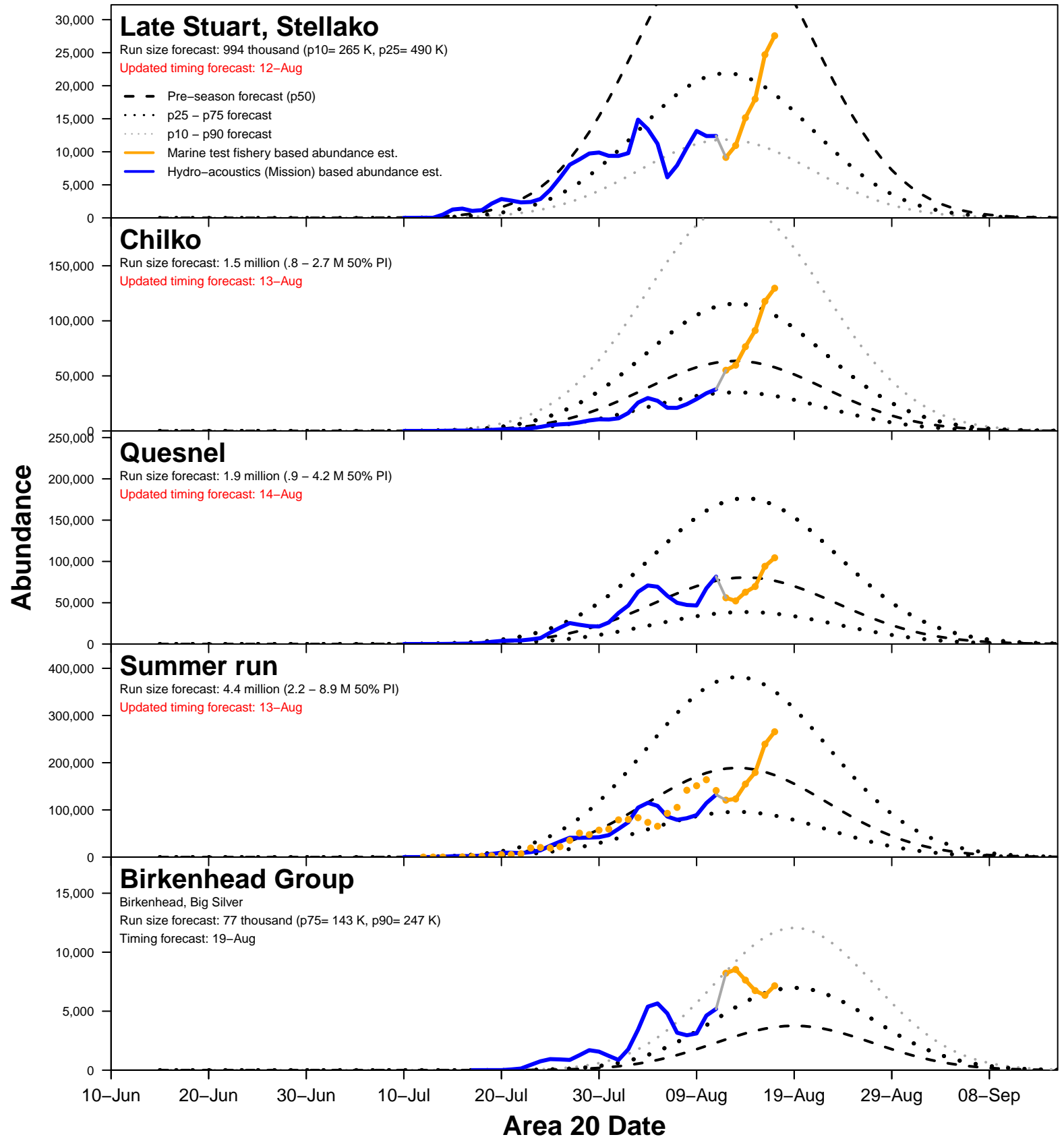
2022 Fraser River sockeye salmon daily migration

Summer run timing updated (3 days later)



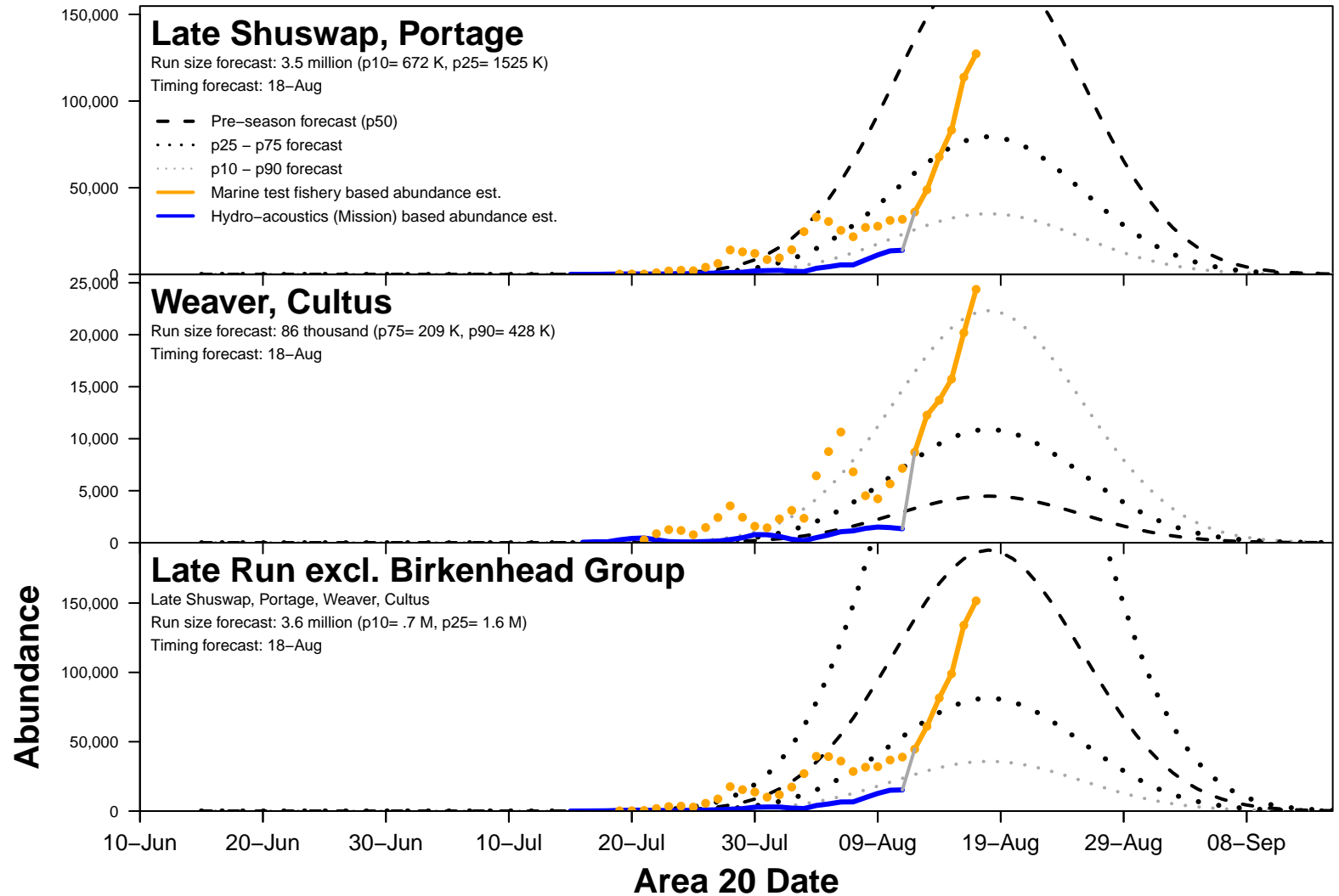
2022 Fraser River sockeye salmon daily migration

Summer run timing updated (3 days later)



2022 Fraser River sockeye salmon daily migration

Summer run timing updated (3 days later)



2022 Fraser River sockeye abundance en-route to Mission

Current date: 18-Aug

	Escapement past Mission through 17-Aug	Projected abundance en route to Mission based on marine test fishery data ^{1,2}									Escapement + projections through 23-Aug
Area 20 date		12-Aug	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	Total	80% PI ³		
Mission date		18-Aug	19-Aug	20-Aug	21-Aug	22-Aug	23-Aug		10p	90p	
Total Fraser	2,096,300	128,300	178,800	249,800	270,500	299,800	536,300	1,663,500	1,007,400	2,434,100	3,759,800
Early Stuart	243,300	0	0	0	0	0	0	0	0	0	243,300
Early Summer Run	494,500	6,600	13,200	18,100	3,500	7,000	13,000	61,400	30,100	127,100	555,900
Chilliwack	7,500	0	0	0	0	0	0	0	0	0	7,500
Pitt/Alouette/Coquitlam	24,300	0	0	0	0	300	300	600	300	1,200	24,900
Nadina group ⁴	258,500	2,200	4,200	4,200	300	2,800	5,500	19,200	9,400	39,700	277,700
Early Thompson ⁵	204,200	4,400	9,000	13,900	3,200	3,900	7,200	41,600	20,400	86,100	245,800
Summer Run	1,259,700	81,000	110,200	136,800	171,900	188,400	321,900	1,010,200	616,200	1,454,700	2,269,900
Harrison / Widgeon ²	6,700	0	0	200	300	400	2,000	2,900	1,800	4,200	9,600
Late Stuart / Stellako	179,400	5,700	10,200	12,400	17,600	19,400	33,700	99,000	60,400	142,600	278,400
Chilko	303,000	38,800	48,000	72,400	86,200	93,200	155,800	494,400	301,600	711,900	797,400
Quesnel	761,400	36,300	51,300	51,800	67,800	72,900	127,500	407,600	248,600	586,900	1,169,000
Raft / North Thompson	9,200	200	700	0	0	2,500	2,900	6,300	3,800	9,100	15,500
Late Run	98,800	40,700	55,400	94,900	95,100	104,400	201,400	591,900	361,100	852,300	690,700
Birkenhead / Big Silver	45,500	7,000	5,600	11,400	3,900	2,900	10,400	41,200	25,100	59,300	86,700
Late Shuswap / Portage ²	45,200	26,800	40,200	66,000	80,600	85,700	159,600	458,900	279,900	660,800	504,100
Weaver / Cultus ²	8,100	6,900	9,600	17,500	10,600	15,800	31,400	91,800	56,000	132,200	99,900

¹ En route catches are incomplete: catches from present and future fisheries must be deducted from projections and added to the catches removed

² Projected abundances en route to Mission include Harrison and Late runs, an uncertain number of which are expected to delay

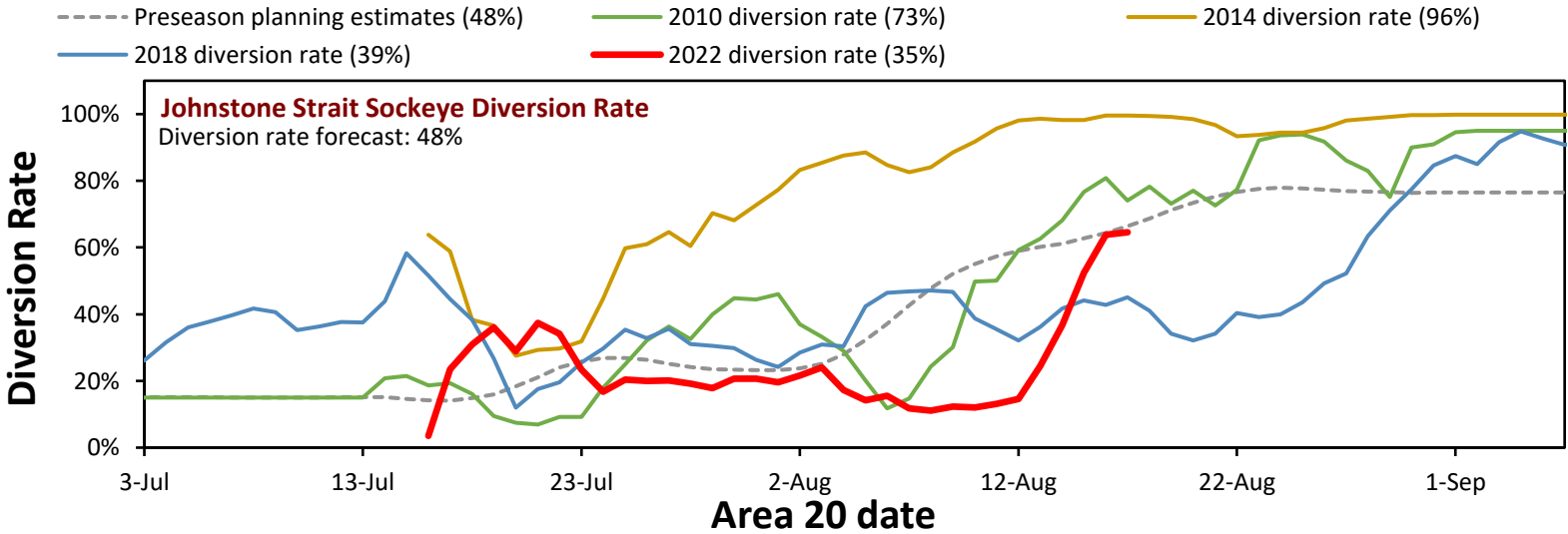
³ 80% Probabability Interval: there exists an 80% chance that the true abundance lies within this interval

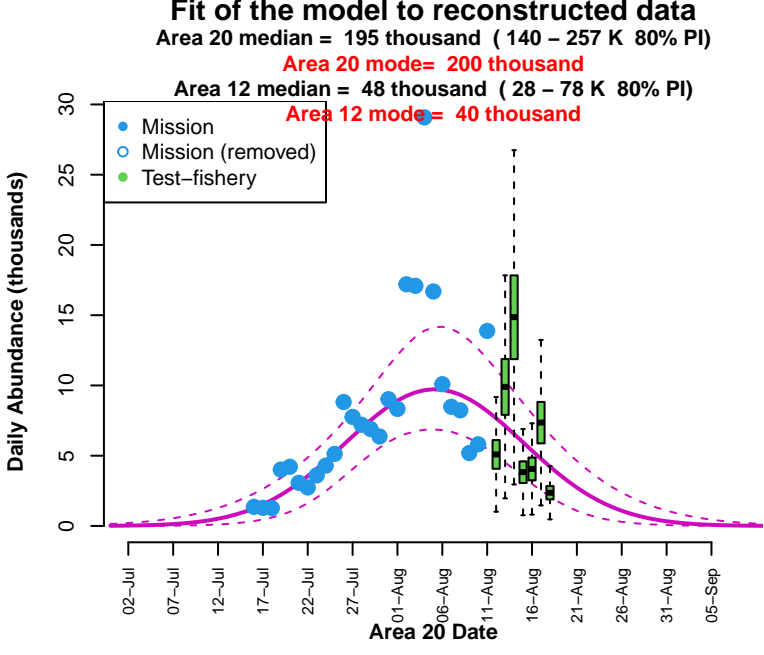
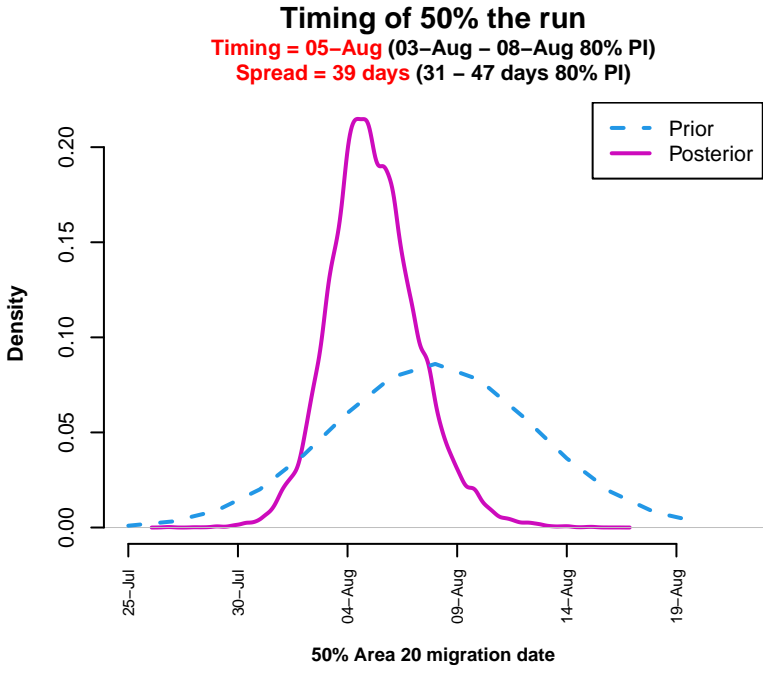
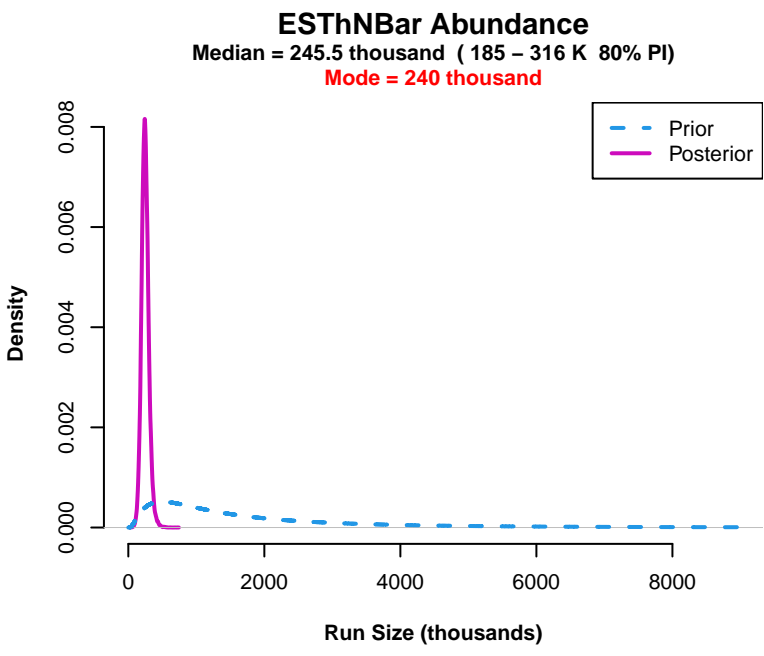
⁴ Nadina / Bowron / Gates / Nahatlatch / Taseko

⁵ Early South Thompson / North Barriere

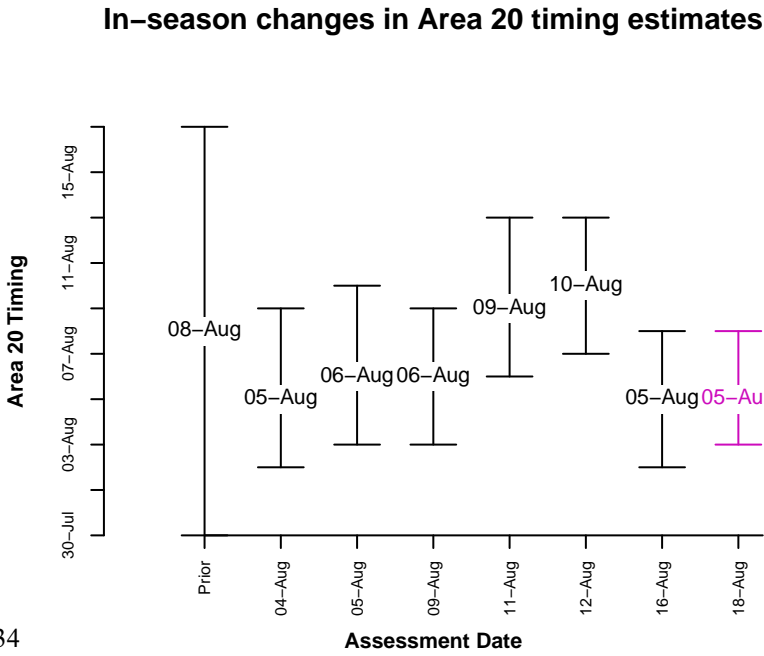
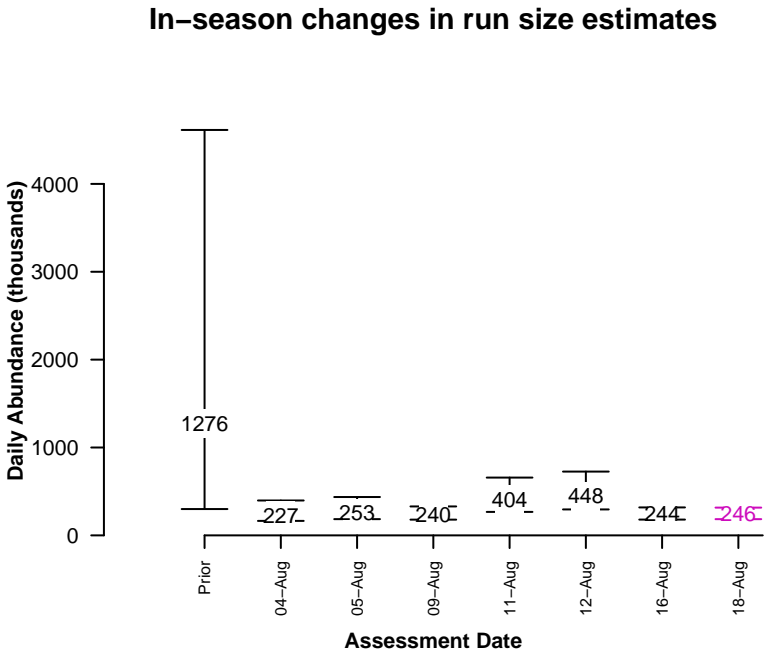
2022 Fraser River sockeye diversion rates through Johnstone Strait

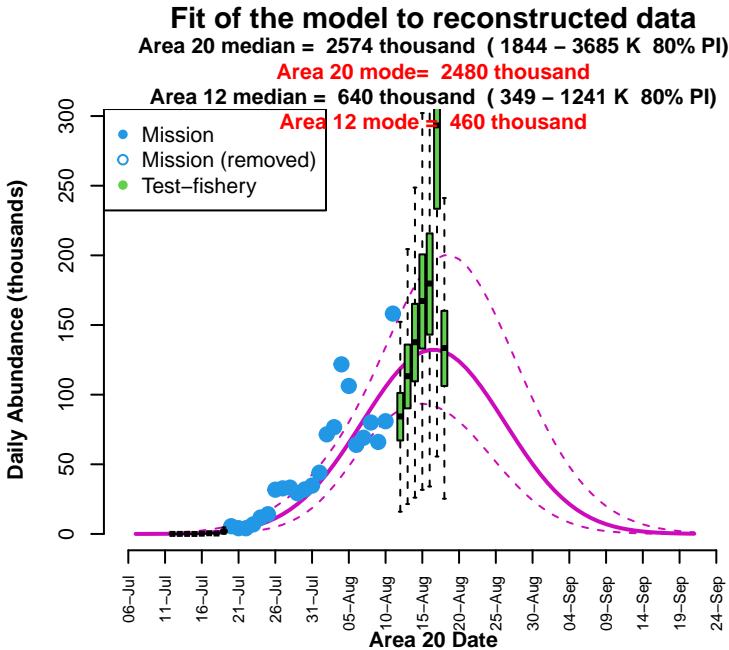
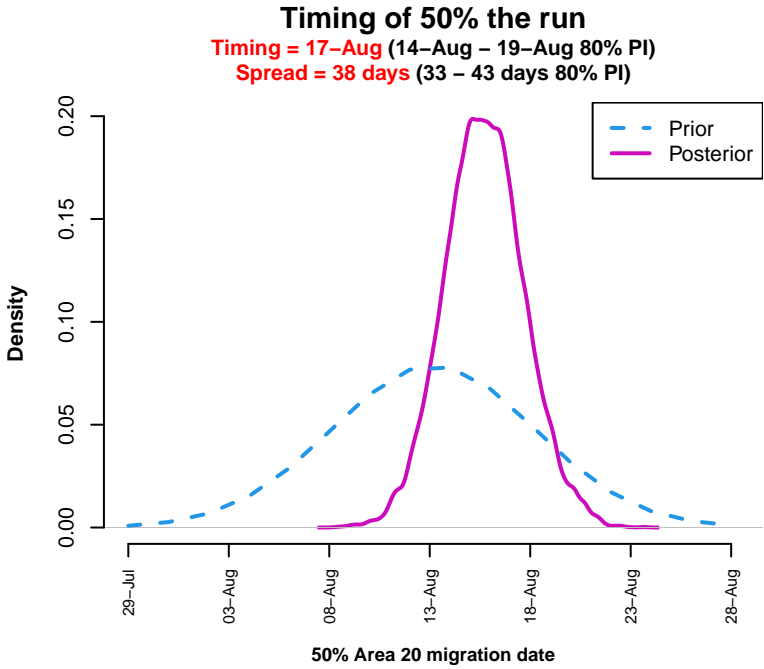
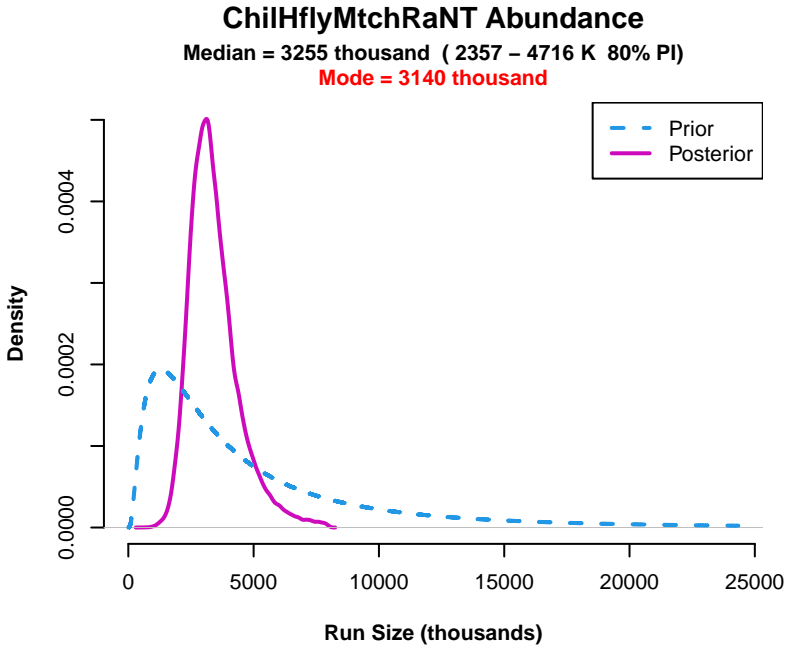
	5-day average
Diversion rate	65%





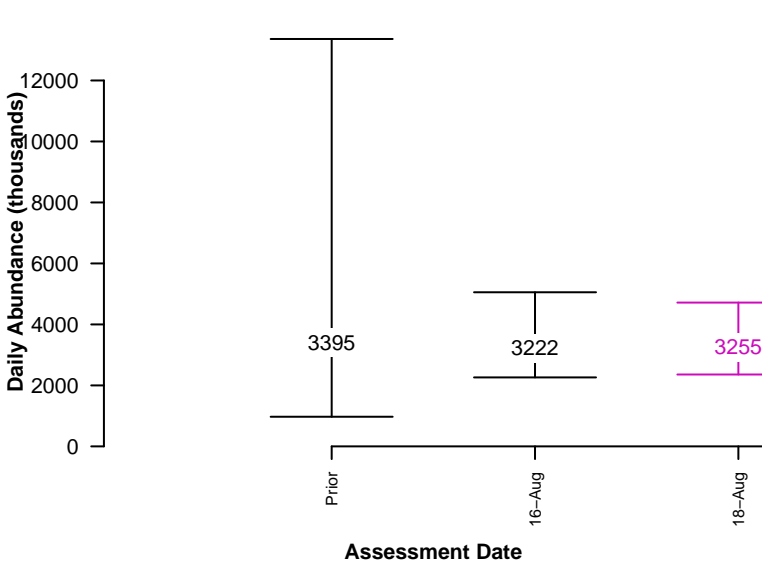
	Run Size Statistics
25% PI	213K
75% PI	280K
p10 (Prob>p10)	299.8K (15%)
p25 (Prob>p25)	607K (0%)
p50 (Prob>p50)	1276K (0%)
p75 (Prob>p75)	2567K (0%)
p90 (Prob>p90)	4614K (0%)
Mission to-date	175 K (114 – 257 K 80% PI)
% Mission to-date	71 % (46.5 – 104.8 % 80% PI)
Projected+Tails	61,000 (32 – 106 K)
Tails	25,000 (10 – 51 K)



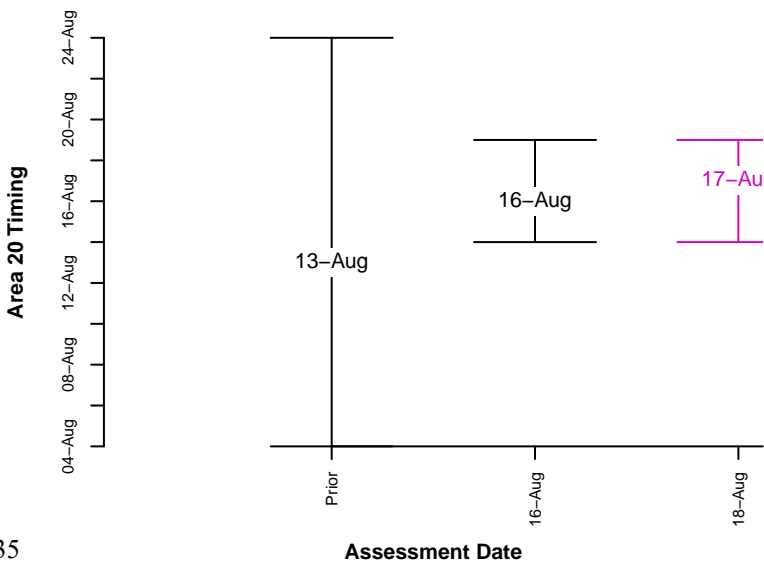


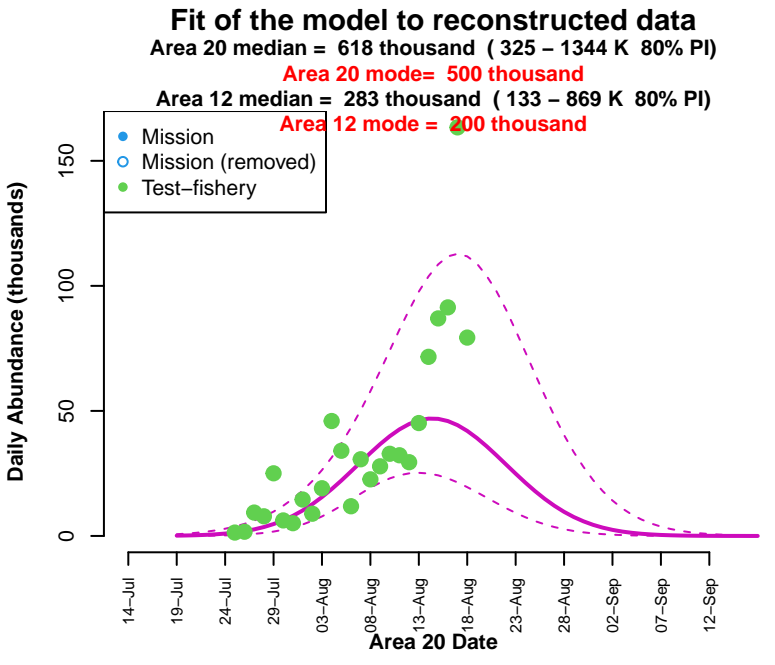
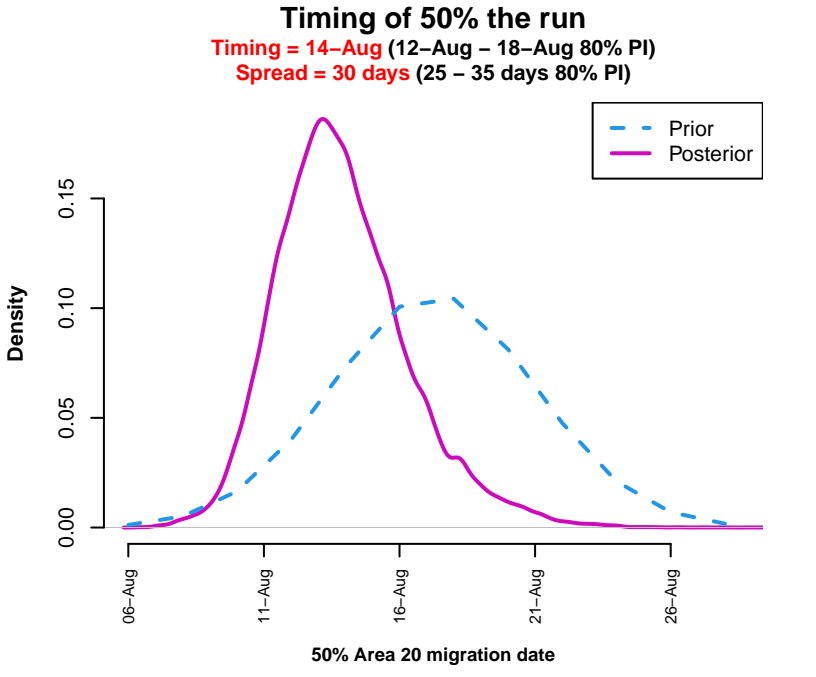
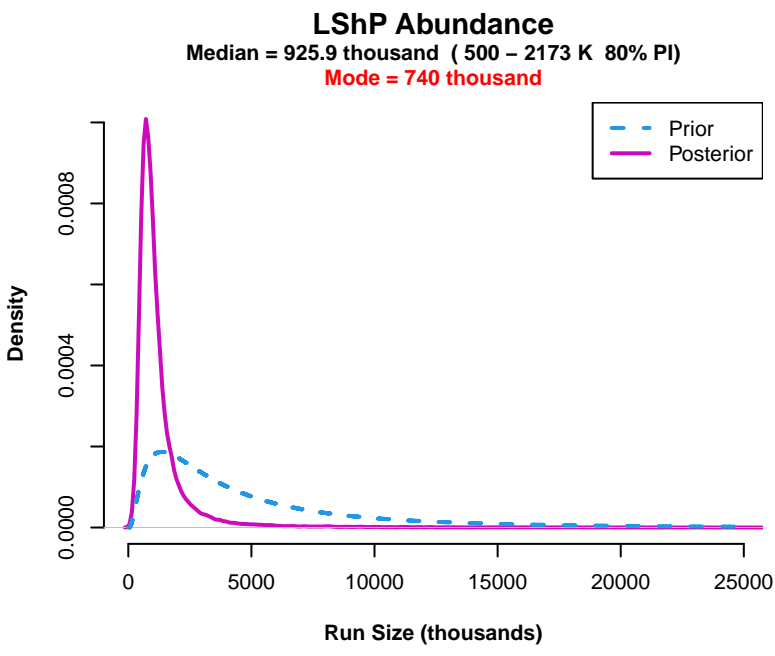
	Run Size Statistics
25% PI	2745K
75% PI	3906K
p10 (Prob>p10)	972.3K (100%)
p25 (Prob>p25)	1735.9K (99%)
p50 (Prob>p50)	3395K (44%)
p75 (Prob>p75)	6890K (1%)
p90 (Prob>p90)	13361K (0%)
Mission to-date	976 K (687 – 1290 K 80% PI)
% Mission to-date	30 % (21.1 – 39.6 % 80% PI)
Projected+Tails	2,250,000 (1391 – 3722 K)
Tails	1,472,000 (839 – 2639 K)

In-season changes in run size estimates

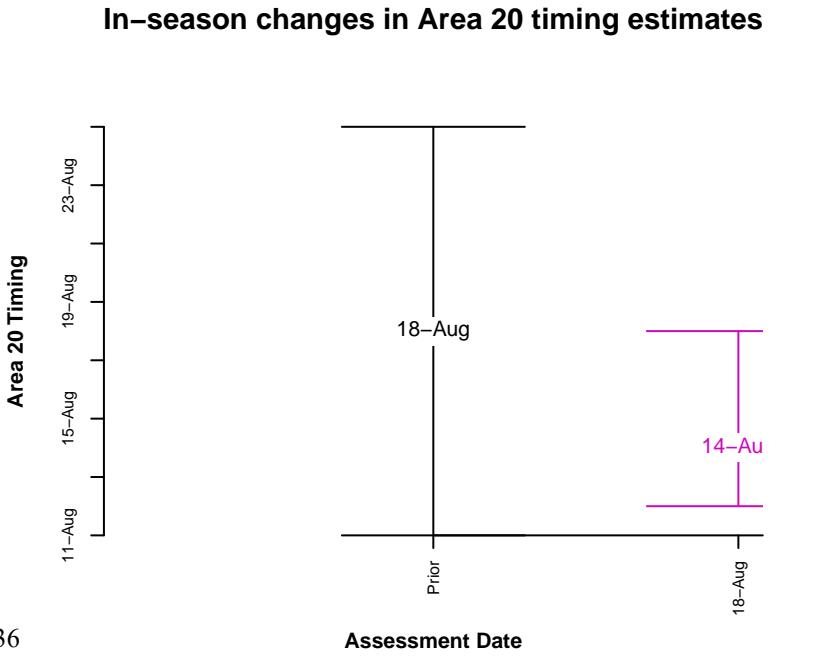
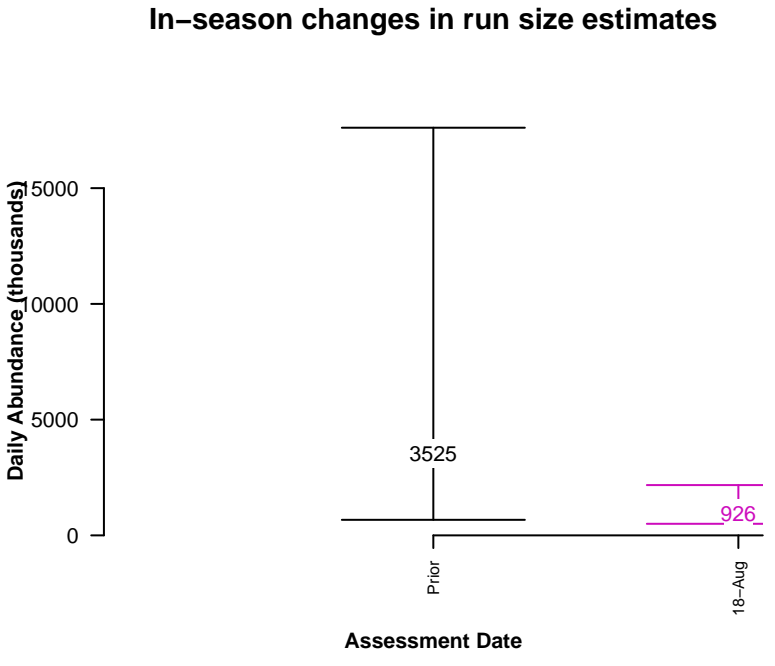


In-season changes in Area 20 timing estimates



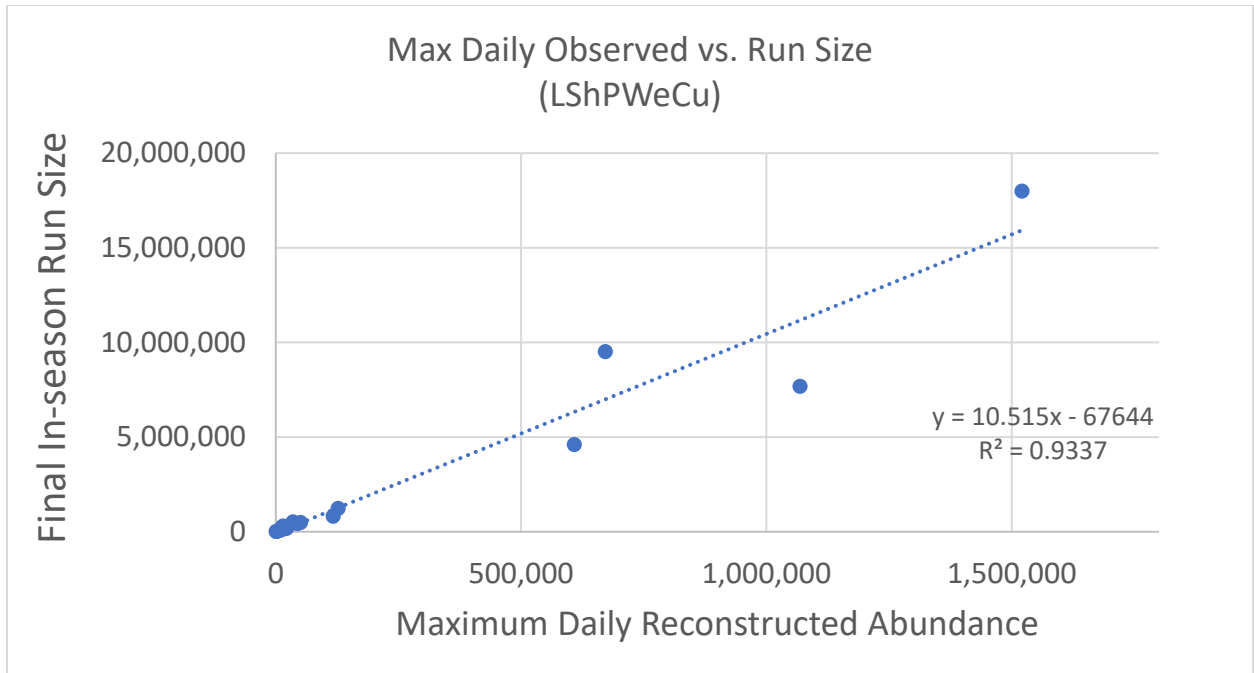


	Run Size Statistics
25% PI	667K
75% PI	1352K
p10 (Prob>p10)	672K (74%)
p25 (Prob>p25)	1525K (20%)
p50 (Prob>p50)	3525K (4%)
p75 (Prob>p75)	7808K (1%)
p90 (Prob>p90)	17610K (0%)
Mission to-date	K (- K 80% PI)
% Mission to-date	% (- % 80% PI)
Projected+Tails	586,000 (261 – 1663 K)
Tails	305,000 (117 – 1038 K)



Maximum abundance on a day as an indicator of run size

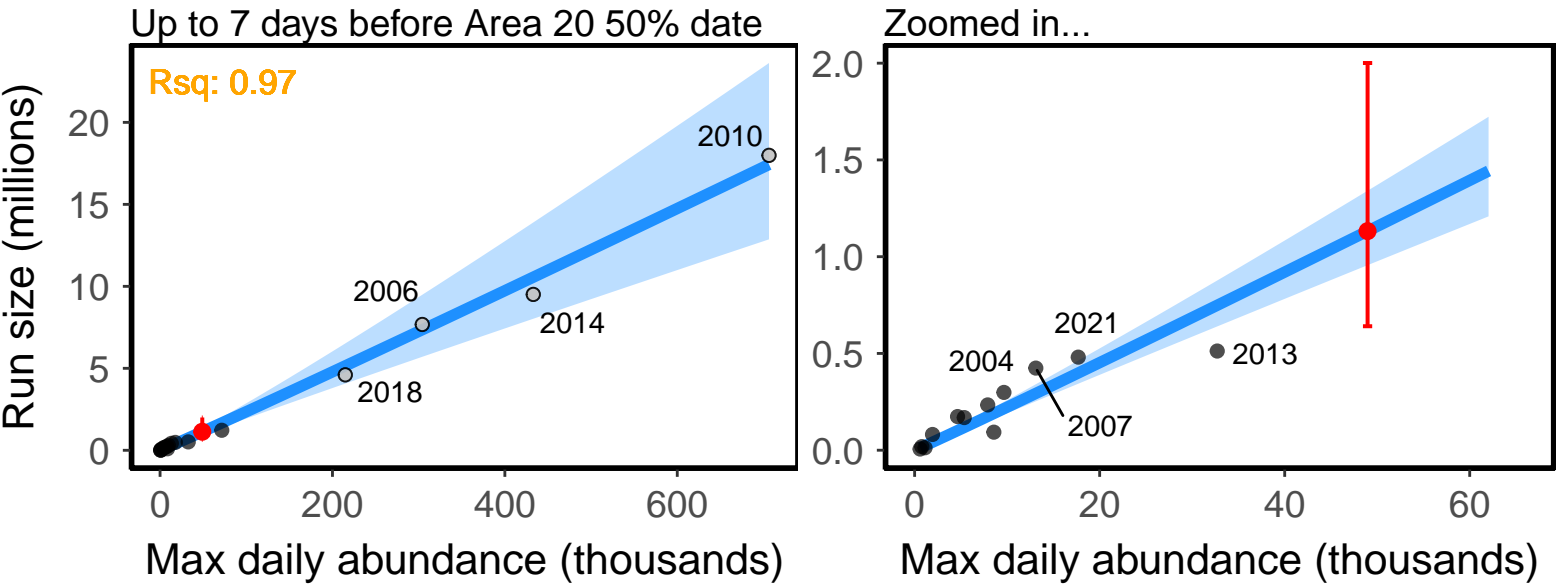
- For some stocks there appears to be a strong relationship between the maximum daily abundance observed over the course of the season and the overall run size of the stock



- However, maximum abundance is likely to occur around the peak of the run, so we wanted to see how this tool performed when we did not have a full timeseries and whether maximum daily abundance *prior* to the assumed Area 20 50% date could still provide an indication of run size, especially given uncertainty in in-season timing estimates.
- We focused on the Late Shuswap/Portage/Weaver/Cultus aggregate for which the in-season run size uncertainty is larger given that it is not possible to confirm marine abundances until post-season due to delayed upstream migration. Thus, an alternative tool that could provide an early run size estimate would be useful for fisheries planning.
- We ran a retrospective evaluating how well maximum daily abundance up to a certain number of days prior to each year's Area 20 50% date predicted run size. We found that maximum abundance predicted run size well, even up to a week (7 day offset) prior to the Area 20 50% date. The tool was more likely to perform well prior to the Area 20 50% date, filling a gap in assessment tools.

Run Size based on Maximum Daily Abundance

Late Shuswap/Portage/Weaver/Cultus



Offsets	Max Abundance	Prediction	80% PI	Max Abundance Date	Diff to 50% date
7	48,958	1.1 M	0.6 – 2 M	Aug-05	13 days

Inputs	
Inseason Area 20 Date	Aug-18
Have max abundance data (excl. TF projections) up to:	Aug-11
Year range	2004-2021
Years removed	2005

Implications of stock proportions for the return of Late Shuswap/Portage relative to forecast

Data: One method of generating an earlier estimate of LShP using stock composition information is called “SMURFing” (Smolt Method of Updating Run Forecasts). This combines the estimated return of Early Shuswap plus North Barriere sockeye (ETho) with ratios of LShP/ETho estimated from samples of the juvenile outmigration in 2020. Here the juvenile sample is examined and stock proportions relevant to expected LShP returns are discussed.

Table 1. *Number of individuals identified as Early Shuswap plus North Barriere versus Late Shuswap plus Portage in 2020 juvenile samples as estimated by DNA and resulting ratios*

Stock group	Hakai Inst early	Hakai Inst late	AMorton a12	AMorton a13	Total
UBar	0.0	0.0	0.0	0.0	0.1
ESTh	3.3	18.8	30.8	25.0	77.9
LShP	7.2	54.1	99.9	85.5	246.7
LShP / ETho	2.1	2.9	3.2	3.4	3.2

Juvenile samples were obtained from Hakai and from Raincoast, for a total sample size of 652. These samples comprised 528 Fraser sockeye with 325 of those being from LShP and ETho. The overall LShP/ETho ratio of 3.2 was only slightly larger than the median estimate of 3.1 for the estimated proportion across sub-samples.

Sample size: The 2020 juvenile sample included 325 LShP and ETho sockeye, an order of magnitude less than in 2012 (3,653) and 2016 (2,478). The uncertainty resulting from small samples is hopefully captured by the estimation methodology. Unfortunately, the number of different sampling dates, locations, and methods was limited in 2020, constraining our ability to assess the robustness of the estimated ratio.

Other stock proportion information in support of the SMURFing estimate: The 2022 forecast indicates LShP should strongly dominate the return of Late-run sockeye with 3.5 million versus 0.16 million Weaver/Cultus/Birkenhead/Big Silver sockeye, for a ratio of almost 22 at the p50 (17 at the p10 and 26 at the p90). Assuming similar timing among these stocks, we can sum identified individuals and estimate abundance ratios. These are consistently lower than forecast and this result seems to be temporally robust, though somewhat different in Johnstone Strait versus Juan de Fuca Strait.

Table 2: *Numbers of Late Shuswap and Portage (LShP) and combined Weaver, Cultus, Birkenhead and Big Silver (WeCuBiBS) sockeye detected in stock composition samples collected by route and gear type in 2022 to August 15.*

Catch date	Sample sizes of LShP and other Late-run sockeye				Ratios of LShP/Other	
	JSt LShP	JSt Other	JdF LShP	JdF Other	JSt	JdF
Before Aug 5	159	25	111	49	6.4	2.3
Aug 5 onward	201	56	246	121	3.6	2.0

The relative proportion of LShP seems to have been somewhat higher in Johnstone Strait than in Juan de Fuca Strait, but considerably lower than 22x the other Late-run stocks. Consistency of this result across date ranges and gear types suggests that differences in migration behaviour (timing and diversion) and

vulnerability to gear are not responsible for the low ratio. It should be noted that the highest ratio (6.4) was observed early in Johnstone Strait when migration abundances through that route were small.

While possible that strong returns of BiBS and WeCu could be responsible for the result in low LShP ratios, to achieve a ratio of 3.0 they would have to return at a strength greater than 7x their p50 forecast (almost 2x their p90 forecast). The context of these other stock composition ratios improve confidence in the signal provided by the SMURFing estimate, that the return of LShP will be below its p25 forecast of 1.5 million, despite the non-ideal nature of the juvenile sample.

See June 2022 FRP presentation for further details on Smurfing: [6b Assessing Late Shuswap run size using SMURFing.pptx \(psc.org\)](#)

2022 Fraser River run size and timing estimates

The information presented on this page has been prepared by PSC Secretariat Staff. All in-season estimates of run size and timing should be considered draft preliminary estimates unless adopted by the Fraser River Panel.

Preseason forecasts, inseason estimates, and official estimates of run size and associated timing

	Run Size					Run size components					Run Timing ¹					
	Inseason Adopted	Preseason Forecast	Inseason estimate	Inseason 80% Pls ²		Method	Catch + Escapement	6-day Projection ³	Seaward Abundance	Migration Delay	Inseason Adopted	Preseason Forecast	Inseason estimate	Inseason 80% Pls ²		Method
				10% PI	90% PI									10% PI	90% PI	
Total Fraser sockeye		9,775,000					2,435,000	1,905,000	1,227,000	271,000		13-Aug				p50 Forecast
Early Stuart Run	244,000	105,000	244,000	244,000	244,000	Recon	244,000	0	0	0	06-Jul	04-Jul	06-Jul	06-Jul	06-Jul	Recon
Early Summer Run	614,000	1,579,000	627,000	570,000	693,000	Sum	526,000	73,000	28,000	0	30-Jul	06-Aug	31-Jul	28-Jul	02-Aug	Recon
E.Summers excl. E.Thomp		303,000	329,000	317,000	348,000	Recon	303,000	23,000	3,000			28-Jul	23-Jul	23-Jul	24-Jul	Recon
Early Thompson ⁴		1,276,000	298,000	253,000	345,000	Recon	223,000	49,000	26,000			08-Aug	04-Aug	04-Aug	06-Aug	Recon
Summer Run	NA	4,403,000	3,762,000	1,995,000	5,352,000	Sum	1,477,000	1,287,000	989,000	9,000	NA	10-Aug	11-Aug	10-Aug	14-Aug	Recon
Harrison / Widgeon		14,000	17,000	8,000	21,000	Recon	8,000	0	0	9,000		06-Aug	28-Jul	24-Jul	05-Aug	Marine N
Late Stuart / Stellako		994,000	295,000	235,000	363,000	Recon(2)	206,000	48,000	41,000	0		09-Aug	07-Aug	04-Aug	10-Aug	Recon(2)
Chilko/Quesnel/Raft/NT		3,395,000	3,450,000	1,752,000	4,968,000	Recon(2)	1,263,000	715,000	1,472,000	0		14-Aug	16-Aug	08-Aug		Recon(2)
Late Run	NA	3,688,000	1,206,000	676,000	2,577,000	Sum	189,000	545,000	210,000	262,000	NA	18-Aug	13-Aug	08-Aug	16-Aug	Marine N
Alt. Late Run			1,224,000	859,000	1,698,000	Sum			417,000	262,000						
Birkenhead Group		77,000	103,000	68,000	149,000	Recon(2)	55,000	24,000	24,000	0		19-Aug	12-Aug	07-Aug	14-Aug	Recon(2)
Late Shuswap / Portage		3,611,000	926,000	500,000	2,173,000	Model	113,000	417,000	156,000	240,000		18-Aug	14-Aug	12-Aug	18-Aug	Model
Alt. L.Shuswap / Portage			928,000	671,000	1,276,000	SMURF	113,000	417,000	158,000	240,000			14-Aug	11-Aug	16-Aug	Recon
Weaver / Cultus		86,000	177,000	108,000	255,000	Marine N	21,000	87,000	47,000	22,000		18-Aug	13-Aug	07-Aug	15-Aug	Marine N

¹ Run timing refers to the date when 50% of the run migrated past the Area 20 reference point.

² 80% Probability Interval: there exists an 80% chance that the true abundance lies within this interval

³ Normally based on test fishery data. Based on Model if Method = Recon(2).

⁴ Early South Thompson / North Barriere.

Methods for run size & timing estimation

Model	Run size assessment model (median)
Recon	Catch + escapement + 6-day test fish projection + model seaward projection
Recon(2)	Catch + escapement + model projections
Marine N	Reconstruction of CPUE-based marine abundances

Chilko/HflyMtch/Raft-N. Thomp run size based on timing

Catch+Escapement To Date: 1,263,000
Projections: 1,187,000

	Method	Run Size*	% Seaward of Mission
Based on timing of 13-Aug	50% Date	2,777,000	55%
Based on timing of 15-Aug	50% Date	3,387,000	63%
Based on timing of 16-Aug	50% Date	3,747,000	66%
Based on timing of 18-Aug	% Seaward	3,967,000	68%
Based on timing of 20-Aug	% Seaward	4,964,000	75%

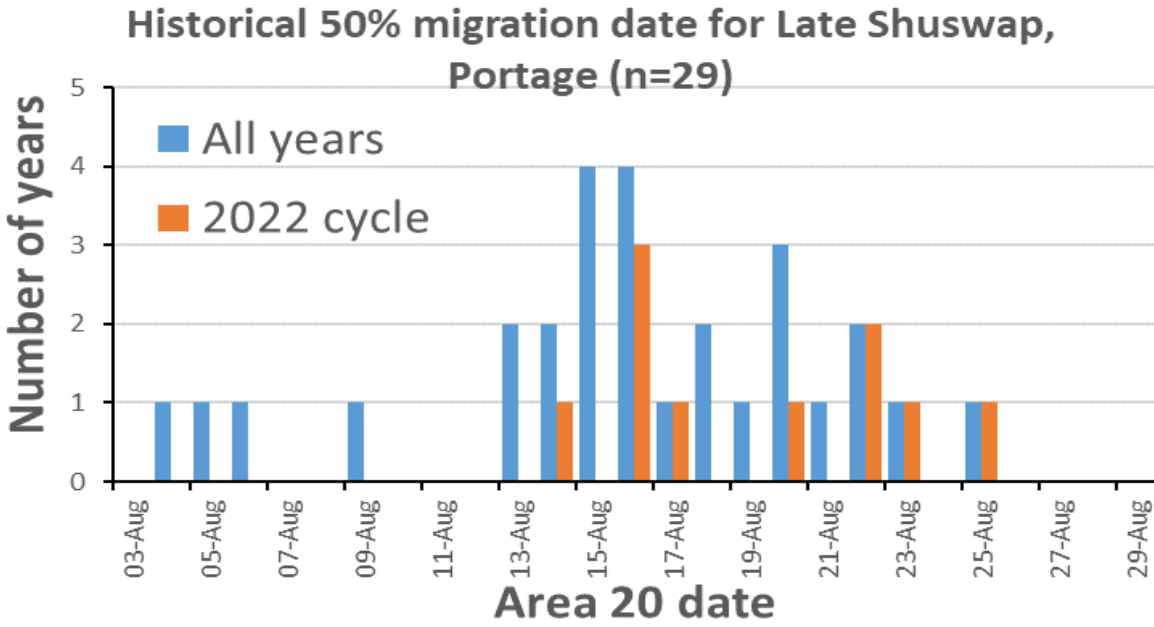
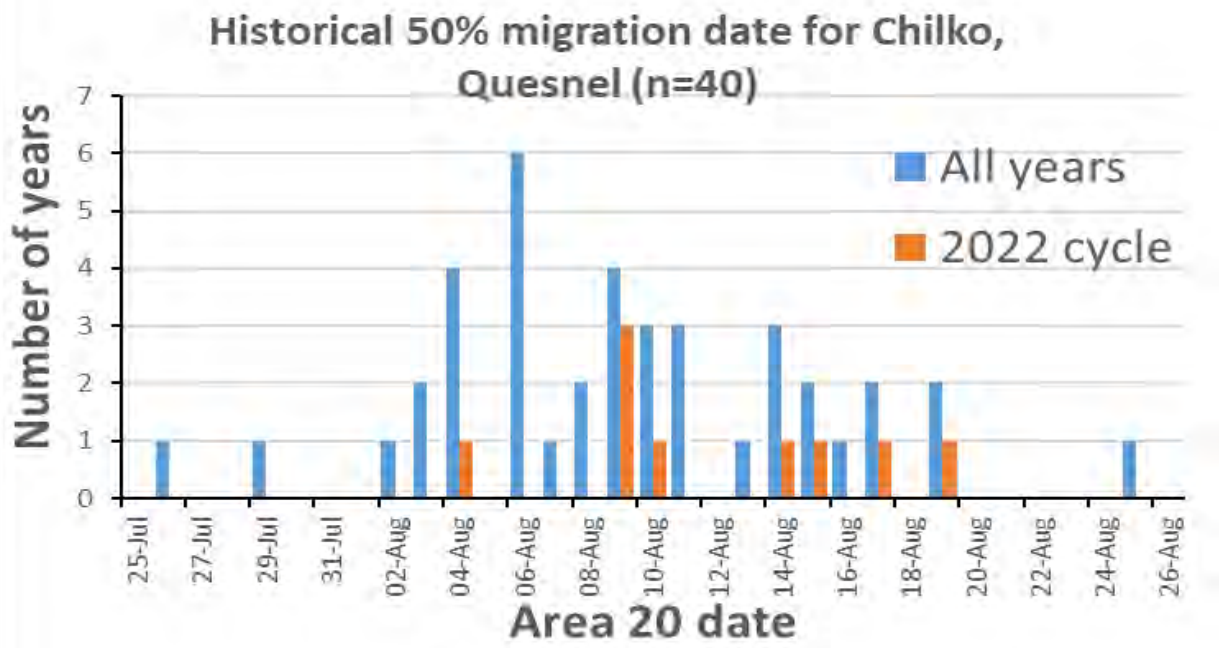
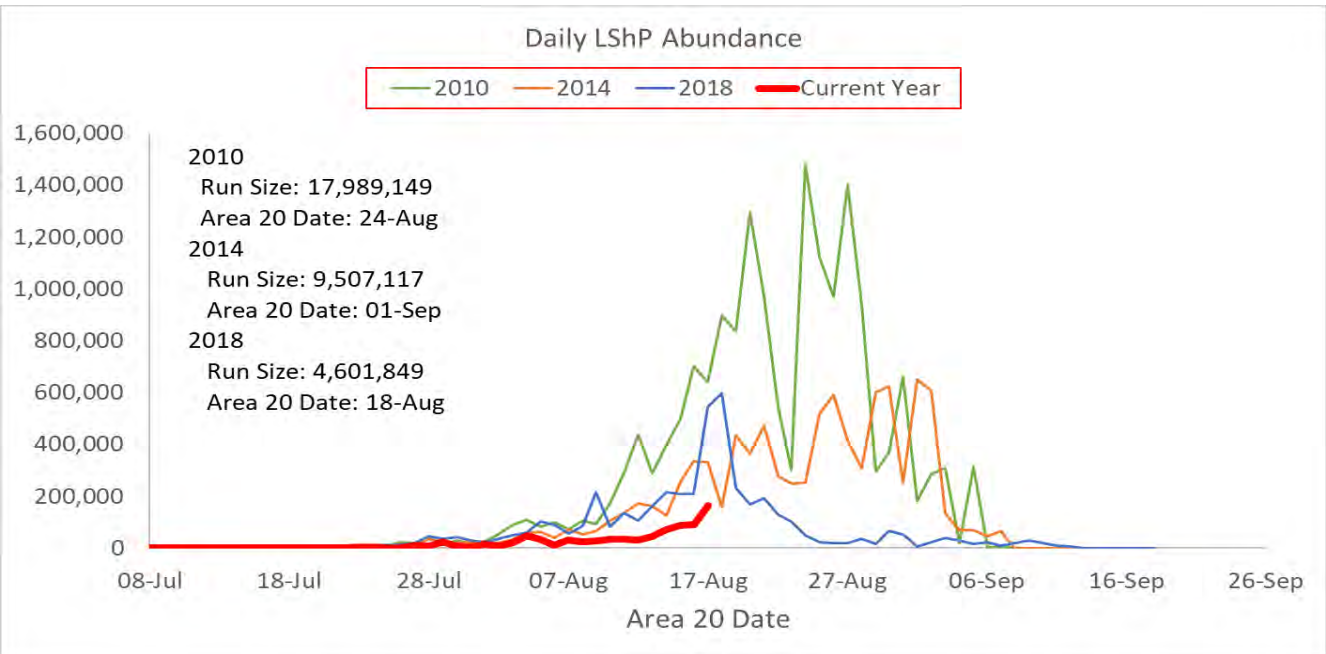
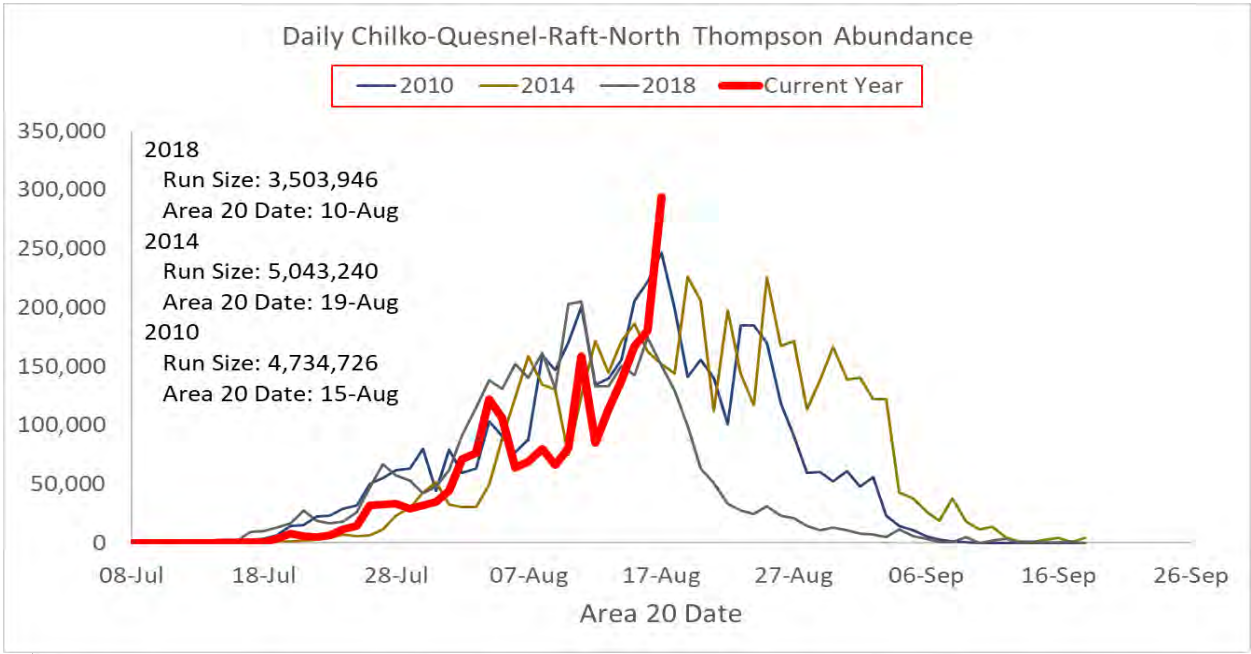
*Based on % seaward in 2010, 2014 and 2018 if timing is later than 17-Aug
*Equal to double the reconstructed abundance if timing is earlier than 18-Aug

Late Shuswap-Weaver Cultus run size based on timing

Catch+Escapement To Date: 133,000
6-day Projection: 505,000

	Method	Run Size*	% Seaward of Mission
Based on timing of 12-Aug	50% Date	922,000	86%
Based on timing of 15-Aug	50% Date	1,411,000	91%
Based on timing of 18-Aug	% Seaward	2,019,000	93%
Based on timing of 21-Aug	% Seaward	2,654,000	95%
Based on timing of 24-Aug	% Seaward	3,485,000	96%

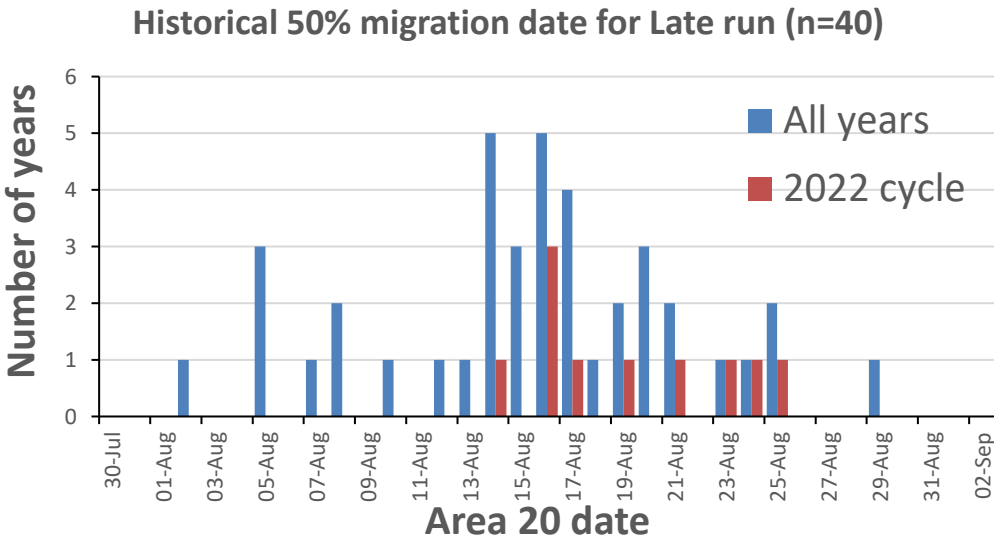
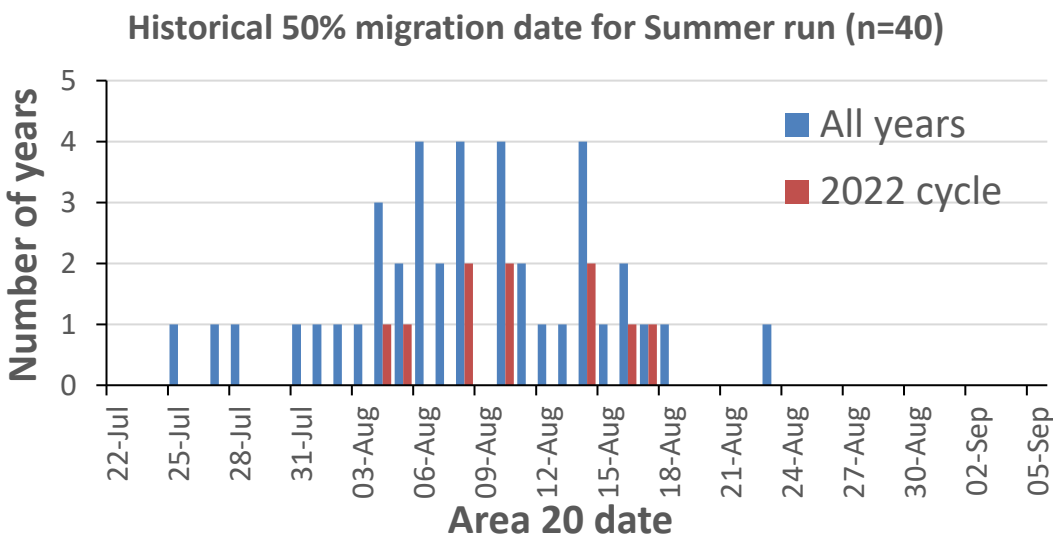
*Based on % seaward in 2010, 2014 and 2018 if timing is later than 17-Aug
*Equal to double the reconstructed abundance if timing is earlier than 18-Aug



Comparisons for Fishing Decisions: Based on Information Available on Thursday August 18, 2022

Compare observed reconstructions of abundance and stock ID to the modelled expectations up until the specified Area 20 dates to determine if observed values are consistent with pre-season conditions used for fisheries planning.

				Total Reconstructed Abundance		Reconstructed Stock ID %		Int'l TAC
				Area 20	Mission	A20PS	A12PS	
				Cumulative Through: 17-Aug		Last A20 Sample: 16-Aug		
Summer	Pre-Season Model Expectations	10-Aug	0	3,386,280	2,339,027	41%	47%	1,909,300
	Current Timing Assumption	10-Aug	0	3,386,280	2,339,027	41%	47%	
		15-Aug	5	2,524,225	1,438,454	51%	55%	
		16-Aug	6	2,339,027	1,262,851	52%	57%	
	Reconstructions (compare to model expectations)			2,482,308	1,394,878	66%	64%	1,893,900
Lates	Pre-Season Model Expectations	18-Aug	0	911,418	----	48%	39%	1,263,300
	Current Timing Assumption	18-Aug	0	911,418	----	48%	39%	
		15-Aug	-3	1,117,555	----	57%	48%	
		21-Aug	3	682,620	----	39%	29%	
	Reconstructions (compare to model expectations)			1,130,522	----	34%	33%	1,252,900



Area 4B56C Catch Projections Table

2022-08-18

This table is used to present potential scenarios of catch projections using alternative sources of catch, abundance and stock ID information.
It does not reflect the true catches observed during a fishery opening.

Scenario Inputs								Expected Total Catches/Catch per day				
Scenario #	Scenario Name	First Day	# Days Open	Last Day	Effort	Abundance Vulnerable to Fishery	Daily Harvest Rate/Vessel	Early Stuart	Early Summer	Summer	Lates	Total Sockeye
1	Planning Model Projections	19-Aug	3	21-Aug	4	261,000	0.12%	0	100	700	500	1,300
								0	0	200	200	400
								0.0%	9.8%	52.2%	38.0%	
2	Current Inseason Projections	19-Aug	3	21-Aug	4	229,000	0.10%	0	0	0	0	900
								0	0	0	0	300
								0.0%	0.0%	0.0%	0.0%	

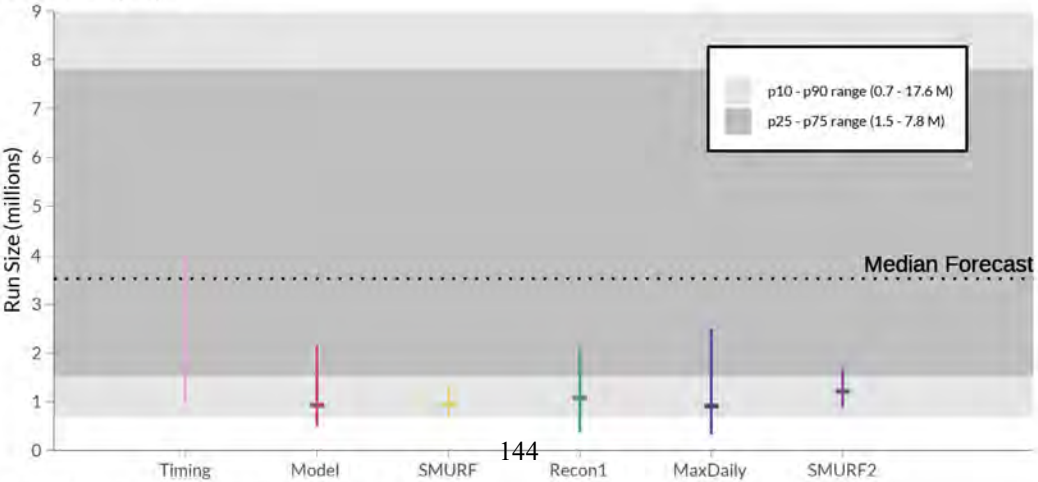
Historical Catch Observations for Area 4B56C

Year	Run Size	Diversion Rate	Days Open	Total Catch	Catch/Day	Annual HR
2006	13,052,000	65%	30	22,976	766	0.58%
2010	28,212,000	73%	32	132,389	4,137	1.33%
2014	18,891,000	96%	13	3,251	250	0.24%
2018	11,032,000	39%	27	54,231	2,009	0.81%

Description of catch, abundance and stock ID methods

Scenario #	Catch Method	Abundance Method	Stock ID Method
1	FPMR HR	FPMR abundance	FPMR stock ID in projected catch
2	Current HR/vessel	Rescaled FPMR abundance	3-Day Stock ID Projections

Run size sensitivity analysis



The information presented on this page has been prepared by PSC Secretariat Staff. All in-season estimates of run size and timing should be considered draft preliminary estimates unless adopted by the Fraser River Panel.

Fraser Panel Bilateral Response to “PSC Secretariat report - Review of Fraser River sockeye run size recommendations and fisheries proposals of August 18, 2022, and subsequent consequences”, following discussions during the Post-season meeting in January 2023.

The Canadian and United States (U.S.) sections of the Fraser Panel (Panel) appreciate the efforts the PSC Secretariat staff (Staff) put into preparing the review of the August 18, 2022 in-season decision- making issues and consequences pursuant to Chapter 4, paragraph 13(e) of the Pacific Salmon Treaty. Both countries understand the complexity of the issues in estimating in-season run sizes and appropriate Panel fishing decisions, in particular when the run timing of a management group is not clearly discernable due to significant uncertainty in the available data. An addendum from the Canadian section of the Fraser Panel (Attachment 1) and the Staff review of the Fraser River sockeye run size recommendations and fisheries proposals of August 18, 2022 (Attachment 2) are attached at the end of this response.

During the January 2023 post-season meetings of the Fraser Panel, the U.S. section of the Panel indicated that they were satisfied and supported the December 20, 2022 report provided by the Staff related to the August 18, 2022 recommendations. Canada expressed the view that the assessment was incomplete and that Canada had a different perspective than that expressed by the Staff, in particular related to impacts on future Canadian fisheries. Canada also raised concerns related to the in-season process that led to the adoption of the run sizes and U.S. recommended fisheries. This document is meant to capture the Canadian and U.S. Panel section’s perspective of the Staff’s report.

Canada’s perspective:

Canada’s biggest concern was the reasoning behind the August 18, 2022 recommended run sizes for Summer and Late Run management groups, considering that the peak run timing for both groups may not have been observed in the data. Staff indicated that the “uncertainty associated with the Summer Run run size was substantial and did not preclude reaching the preseason forecast of 4.4 million”. Canada felt that the available information could equally have been interpreted as suggesting that the run size for Summer Runs was well below forecast as suggested by the Staff’s reconstruction model estimate of 3.762 million. Similarly, for Late Runs, the Staff’s recommended run size of 2.0 million was based on the results of one model, that the Staff deemed most appropriate, however assumed much later timing than the in-season data was suggesting. Several alternative estimates were described that indicated high uncertainty in the Late Run run size estimates, ranging from 800 thousand to 2.0 million, with the majority of the estimates suggesting a run size of around 1.2 million. However, the least precautionary model was recommended by the PSC because it was, from their perspective, the least biased method to use early in the return of Late Run sockeye. Canada recommended a run size estimate for Late Run sockeye based on the p25 pre-season forecast of 1.6 million as a compromise between the 2.0 million and the 1.2 million range of estimates produced by several other models Staff provided. Because of the significant uncertainty in the data, and the poor returns and earlier timing observed in the South Thompson Early Summers and the Late

Stuart/Stellako Summer Run returns, Canada was concerned that the Staff's run size recommendations seemed to be inconsistent with all available assessment information. Run size information provided in the August 22, 2022 Panel meeting confirmed Canada's fears with lower run size recommendations for Summer and Late Run sockeye of 3.5 million and 1.2 million, respectively. Impacts of these run sizes were not assessed by the Staff in this review which are the run sizes that impacted Canadian fisheries decisions prior to September 6, 2022. U.S. harvests from the Panel approved fisheries on August 18, 2022, resulted in Late Run harvests that were well over the projected catches provided by the Staff on August 18, 2022. This, combined with the reduced run sizes adopted by the Panel for both Summer and Late Run sockeye on August 22, 2022 resulted in a U.S. Late Run catch, at that time, that exceeded the U.S. proportionately distributed TAC of 0 for Lates at the lower run size by 124,390 (August 23, 2022 in-season distribution). Canada understands that there is no overage as a result of these catches as defined in Chapter 4, however, the extent of the Late Run harvest in the U.S. fisheries (from the August 18, 2022 adopted run sizes and fisheries) resulted in Canada needing to close marine First Nations FSC fisheries, and delayed the start of Canadian commercial fisheries (Areas B, D and H by two weeks), eliminated the Area E fishing opportunity (in late August as per the pre-season fishing plan), and delayed the start of the recreational fisheries (by approximately 3 weeks).

U.S. Perspective:

As indicated earlier, the U.S. is supportive of the findings and rationale in the Staff report regarding the basis for the August 18, 2022 run-size recommendations and their assessment of the proposed U.S. fisheries, given the information that was available at the time. These fisheries were reduced in days from pre-season model planned fisheries and responsive to the in-season assessment from the Staff. The U.S. considered incidental harvest on Early Summer run sockeye in the fisheries proposal (one of the primary concerns noted by Canada on August 18, 2022) with a projected exploitation rate under 16.5% of the Low Abundance Exploitation Rate. On August 19, 2022 the U.S. delivered a rationale letter to Canada and Staff by the U.S. that outlined the justification for the August 18, 2022 fishery proposals. The justification letter included a summary of available U.S. TAC at the Panel approved run sizes totaling a 245,260 sockeye balance, a rapidly increasing diversion rate indicating a limited number of days available to catch Summer Run sockeye before diversion of sockeye shifts to the north, and a trend in CPUE of test catch indicating that a peak of the Summer and Late Run sockeye components were yet to be reached. Additionally, while the estimated run sizes of Summer and Late Run sockeye decreased shortly after August 18, 2022, these management groups did increase later in-season, on August 26th and September 6th, 2022, with the Late Run projected to be 2.15 million and Summers at 3.8 million at the September 28, 2022 Panel meeting. The U.S. also finds that the Staff's report did assess the implications of the U.S. fisheries, as implemented, to the Canadian domestic fisheries. Further, the Staff indicated, and the U.S. concurs, that these implications to Canadian fisheries were primarily due to the run size adjustment on August 22, 2022 and not primarily from the prosecution of U.S. fisheries adopted on August 18, 2022.

Moving Forward:

Despite the differences in opinions between Canada and the U.S. with respect to the Staff's Review, discussions during and after the January 2023 PSC post-season meeting of the Panel resulted in bilateral agreement on the 13 suggested recommendations provided in the Review. These recommendations are not solely related to the decisions made on August 18 but also encompass recommendations associated with actions and decisions leading up to that meeting.

Recommendation 1: Consider increasing the MA based on in-season observed and forecasted estimates of river temperature and discharge exceeding thresholds instead of waiting for in-season confirmation of en-route losses, in years with low run size or for stocks with potential conservation concerns.

Response: The Parties agree that the current process the Panel uses to adopt Management Adjustments both pre- and in-season addresses this recommendation and sees no reason to change.

Recommendation 2: Take into account run size assessment uncertainty when setting escapement goals for Late run (and pink) salmon.

Response: Canada is responsible for setting escapement goals for Fraser Sockeye and Pink salmon which utilizes assessment of different options using the Fraser River Sockeye Spawning Initiative (FRSSI) model which is then used to develop two to four options that Canada consults on during the pre-season planning process. Options generally consist of something similar to the plan used on the previous cycle line return year as well as one or more conservative options designed to increase the likelihood of achieving escapements that meet some sort of conservation metrics. Future attempts to incorporate run size uncertainty in FRSSI assessments could be considered, but are likely not required as part of this review.

Recommendation 3: The base case fisheries planning model adopted by the Panel should include fisheries that meet both countries' criteria of small but acceptable catch for management groups with limited or no TAC.

Response: The Parties agree with this recommendation and plan to develop agreed upon model runs at the p50 and p25 levels, at a minimum, and more if required.

Recommendation 4: Canada should ensure timing and diversion rate forecasts are provided to the Technical Committee ahead of its June meeting.

Response: Canada has addressed this issue and has included this task as a specific work plan item for the Fraser and Interior Area Sockeye and Pink Analytical Biologist position.

Recommendation 5: Pre-season, the Panel should be presented with and discuss results of the fisheries planning model assuming alternative run size scenarios.

Response: The Parties agree with this recommendation and as mentioned in Recommendation 3 the Parties plan to develop two or more pre-season model runs in future.

Recommendation 6: The U.S. (and Canada) should ensure catches reported to PSC staff are timely and accurate.

Response: The Parties agree that timely and accurate catch reporting is a critical element of in-season management for the Panel. The U.S. is currently looking into modifying some aspects of their preliminary catch accounting process to address the issues that arose during the 2022 season that resulted in a catch of just over 33,000 being reported in November, three months after the completion of the U.S fisheries.

Recommendation 7: Ahead of the 2023 fishing season, Canada and the U.S. should have further discussions about the small but acceptable criterion for management groups without international TAC, including the scenario when no Fraser sockeye management groups have international TAC during pink years, and the scenario for fisheries that have high incidental harvest rates (e.g., gill net fisheries when targeting pink salmon).

Response: These discussions are planned to occur before the 2023 season during the pre-season planning and modelling meetings.

Recommendation 8: Canada and the U.S. should evaluate to what extent it is appropriate to rely on a proportional share of the Low Abundance Exploitation Rates (LAERs) to define small but acceptable incidental harvest rates when no international TAC is available for some management groups.

Response: The Parties will be discussing this and other potential approaches to addressing small but acceptable.

Recommendation 9: The U.S. could consider a) decoupling consecutive Treaty Tribal and All Citizen fisheries in Area 7 and 7A, requiring an additional Panel meeting in between or b) improving the ability of the U.S. to check Treaty Tribal catches prior to proceeding with All Citizen fisheries or vice versa.

Response: The U.S. is considering modifications to how some fisheries are managed in the future which would result in more controlled fisheries and improved catch reporting. More discussion in advance of the season related to the modified approaches to managing U.S. fisheries is expected to occur prior to the 2023 fishing season.

Recommendation 10: Fisheries proposals not more than three days into the future may be better. Additional fisheries further into the future could require an additional FRP meeting, or extensions of fisheries openings could be done by establishing improved communications for transmittal of information to crews in the field.

Response: Similar to Recommendation 9 new management approaches are being considered and will be discussed pre-season.

Recommendation 11: Technical Committee meetings should be held independently from Panel meetings, i.e., not combined and not replaced by Panel meetings.

Response: Both Parties agree with this recommendation.

Recommendation 12: When presenting alternative run size estimates based on models with known biases or with expected data quality issues, PSC staff should do a better job of communicating these issues.

Response: Both Parties agree that better communication is essential.

Recommendation 13: PSC staff should indicate when there is insufficient in-season information available to make run size recommendations instead of recommending a run size equal to the forecast.

Response: Both Parties agree that run size recommendations are required when significant fisheries are being considered even when in-season information is insufficient to confirm run timing or the run size for a particular management group. During these circumstances Staff should provide a run size recommendation, for management purposes, from within the range of run sizes generated by the models used to produce run sizes estimates. Staff, FRP Technical Committee, and the Panel should also consider other available in-season information (test fisheries, fisheries data) when developing run size recommendations and proposed fisheries.

The Parties feel that if the recommendations and responses to the recommendations are adhered to in future, the circumstances that occurred in 2022 will be avoided. It is critical that the two Parties be provided the opportunity in-season to have constructive discussions regarding the run size and fisheries recommendations for effective management of Fraser Sockeye and Pink salmon returns.

Attachment 1

Canadian Addendum to
“Fraser Panel Bilateral Response to “PSC Secretariat report -
Review of Fraser River sockeye run size recommendations and fisheries
proposals of August 18, 2022, and subsequent consequences”, following
discussions during the Post-season meeting in January 2023.”

Canada suggests an additional recommendation below.

Recommendation 14: In the event that both parties (Canada and the U.S.) cannot agree on a recommended run size from the PSC secretariat staff or a proposed fishery by either country, the final approval would be deferred until agreement by both parties (Canada and the U.S.) is achieved.

**APPENDIX J: MEMBERS OF THE FRASER RIVER PANEL TECHNICAL COMMITTEE
IN 2022**

Canada	United States
J. Scroggie, Co-Chair <i>Fisheries and Oceans Canada</i>	G. Rose, Co-Chair <i>Northwest Indian Fisheries Commission</i>
M. Veilleux <i>Fisheries and Oceans Canada</i>	A. Seiders <i>Northwest Indian Fisheries Commission</i>
M. Staley <i>First Nations Advisor</i>	M. Agha <i>Washington Department of Fish and Wildlife</i>
K. Campbell <i>First Nations Advisor</i>	M. Bogaard <i>Washington Department of Fish and Wildlife</i>
	T. Siniscal <i>National Marine Fisheries Service</i>

APPENDIX K: STAFF OF THE PACIFIC SALMON COMMISSION IN 2022

EXECUTIVE OFFICE

John Field, Executive Secretary
John Son, Information Technology Manager
Julie Ehrmantraut, Administrative Assistant
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, Manager, Restoration & Enhancement Funds
Victor Keong, Program Assistant, Restoration & Enhancement Funds
Christina Langlois, Administrative Assistant, Restoration & Enhancement Funds

FISHERIES MANAGEMENT DIVISION STAFF

Fiona Martens, Chief Biologist Programs
Catherine Michielsens, Chief Biologist Science

Stock Assessment Group

Merran Hague, Stock Assessment Biologist
Serena Wong, Data & Assessment Biologist
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, Salmon Technician

Stock Monitoring Group

Eric Taylor, Quantitative Biologist
Tosh Sutherland, Manager, Test Fishing Operations
Chris Dailey, Assistant Quantitative Biologist
Rachael Hornsby, Fisheries Biologist
Jacqueline Nelitz, Senior Hydroacoustic Technician
Jordan Maguire, Fisheries Technician
Kristen Hayward, Assistant Fisheries Biologist