2017

Report of the Fraser River Panel to the Pacific Salmon Commission on the 2017 Fraser River Sockeye and Pink Salmon Fishing Season

Prepared by the

Pacific Salmon Commission

November 2018

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REPORT OF THE
FRASER RIVER PANEL
TO THE PACIFIC SALMON COMMISSION
ON THE 2017 FRASER RIVER SOCKEYE AND PINK SALMON FISHING SEASON

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M. Griswold
Troll fisher

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First Nations

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PACIFIC SALMON COMMISSION

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I. EXECUTIVE SUMMARY

Pre-season Planning

1. Pre-season expectations were for a median run size (p50 level, Appendix B) of 4,432,000 Fraser River sockeye salmon and a one in two chance that the run size would be between 2,338,000 and 8,873,000. The median Fraser River pink run size forecast was 8,693,000 (p50 level, Appendix B) with a one in two chance that the run size would be between 6,177,000 and 12,353,000.
2. Pre-season expectations of migration parameters included a 51% diversion rate for Fraser River sockeye and a 50% diversion rate for Fraser River pink salmon through Johnstone Strait. Panel adopted Area 20 50% migration dates were July 1 for Early Stuart, July 20 for Early Summer, August 6 for Summer, August 14 for Late-run sockeye, and August 28 for pink salmon.
3. At median (p50) forecast abundance levels, pre-season spawning escapement goals were 99,000 Early Stuart, 137,200 Early Summer, 1,375,100 Summer and 314,000 Late-run sockeye for a total of 1,925,300 sockeye salmon and 6,000,000 pink salmon (Table 1). The goals for Fraser River pink salmon and for each sockeye management group were established by applying Canada's Spawning Escapement Plan (Appendix B) to their median forecasted run sizes.
4. Management Adjustments (MAs) of 53,500 Early Summer, 82,500 Summer-run and 288,900 Late-run sockeye were added to the spawning escapement targets to increase the likelihood of achieving the targets. The spawning escapement target for Early Stuart sockeye was the entire run size at the median forecast abundance level. This target coupled with the likelihood of some differences between estimates (DBEs) meant that the spawning escapement target was unlikely to be reached and therefore obviated the need for management adjustments for this group (Appendix G, Table G3). Thus, for pre-season planning purposes, potential harvests of Early Stuart sockeye were constrained by the application of a 10% Low Abundance Exploitation Rate (LAER).
5. The pre-season MAs adopted by the Panel for the Early Summer and Summer-run groups were derived from the weighted average proportional difference between estimates (pDBEs) of their components where the weighting factors were based on the median forecast abundance levels of the components. The pDBEs for the Early Summer run component excluding Chilliwack and Pitt and the Summer-run component excluding Harrison were predicted from environmental MA models based on long range forecasts of river temperature and flow. These predictions were then combined with median pDBE values based on subsets of the historical data for Chilliwack and Pitt (Early Summer run) and Harrison (Summer run) to estimate the weighted pDBEs for the aggregates. For the Late-run group, the Panel adopted management adjustments derived from the weighted average of the historical odd-year median (1995-present) for Late-run sockeye excluding the Birkenhead group and historical time series medians (1979-present) for the Birkenhead group.
6. The projected Total Allowable Catch (TAC) of Fraser River sockeye salmon based on the median forecasted abundances and agreed deductions was 1,697,900 sockeye (Table 1), of which 16.5% (280,200 sockeye less small payback of 900 fish) were allocated to the United States (U.S.). The projected TAC of Fraser River pink salmon was 2,615,300 fish, of which 25.7% (672,000 pinks) were allocated to the U.S.
7. Pre-season model runs indicated it was unlikely the Summer-run TAC could be fully harvested due to fisheries constraints required to achieve spawning escapement targets for co-migrating Early Summer and Late-run stocks.
8. The Panel adopted the Management Plan Principles and Constraints, the 2017 Regulations, and the 2017 Pre-season Agreement on Test Fishing Deductions. (Appendices C, D and E).

In-season Management Considerations

9. The in-season marine migration timing (Figure 3) was later than pre-season expectations for all sockeye management groups: 3 days for Early Stuart run, 15 days for Early Summer-run, 6 days for Summer run and 3 days for Late run. The opposite was true for pink salmon timing which was 10 days earlier than the expected timing (Figure 4) causing sockeye and pink salmon migrations to overlap more than expected pre-season. The pink salmon migration also declined precipitously after August 29 which decreased the run size estimates and constrained pink-directed fisheries planning.
10. The overall Johnstone Strait diversion rate (Figure 5) for Fraser River sockeye was 71% compared to the pre-season forecast of 51%. The Fraser River pink salmon diversion rate was 57% instead of 50% that was used in pre-season modelling.
11. Returns for both Fraser sockeye and pink salmon were substantially below median pre-season forecasts (Early Stuart run: 54% below median forecast, Early Summer run: 54% below median forecast, Summer run: 69% below median forecast and Late run: 64% below median forecast; pink salmon run: 59% below median forecast). In context to the pre-season forecast range, the Early Stuart and Late-run returns were between their p10 and p25 forecast levels, the Early Summer-run return was slightly less than its p25 forecast level, and the Summer-run return was less than its p10 forecast level. The pink salmon return was also less than its p10 forecast level.
12. As noted above for the Early Stuart group, the escapement target at the median (p50) pre-season forecast abundance level was equal to the entire run and subsequent in-season run size estimates were even less than this forecast value. Thus no management adjustments were adopted either pre-season or in-season for this group. Fraser River discharge was below average and river temperatures were above average for the duration of the season (Figure 6). For the Early Summer run group excluding Chilliwack and Pitt, higher than average river temperatures resulted in the in-season model predicting a larger estimate of difference between potential spawning escapement and the actual number of spawners on the spawning grounds (DBE) than was predicted pre-season based on the long range forecasts of river temperature and flow. However, by the time sufficient data were available in-season to predict the DBE, the lower in-season estimate of return coupled with the pre-season DBE value adopted by the Panel were sufficient to cause the Early Summer-run to be managed under a low abundance exploitation rate (LAER). Similarly, no in-season updates to DBEs were adopted for the Summer-run and Late-run groups in 2017 because the in-season run sizes for these management groups resulted in the groups being managed under a (LAER) scenario. Thus DBEs were not relevant factors in determining management actions for these groups.

Run Size, Catch, Escapement and Migration patterns

13. Returns of adult Fraser sockeye totalled 1,455,400 fish (Tables 7 and 8), and were 1M fish less than the escapement of 2,479,500 fish in the brood year (2013). This return was one of the smallest over the last 50 years. Divided into management groups, adult returns totalled 45,900 Early Stuart, 157,200 Early Summer-run, 1,043,500 Summer-run and 209,000 Late-run sockeye.
14. Catches of Fraser River sockeye salmon in all fisheries totalled 87,200 fish, including 71,900 fish caught by Canada, 1,500 fish caught by the U.S. and 13,800 fish caught by test fisheries (Table 7). Almost all the Canadian catch occurred in First Nations FSC fisheries (Food, Social and Ceremonial, 71,700 fish). In Washington, catches were in ceremonial Treaty Indian fisheries. Fisheries in Alaska harvested 18,700 (preliminary number) Fraser sockeye. The overall harvest rate was 6% of the run, which is the smallest in recent years (Figure 8).
15. DFO's near-final estimates of spawning escapements to streams in the Fraser River watershed totalled 940,100 adult sockeye (Tables 7 and 8). This was less than half the brood year escapement of 2,479,300 adults and the lowest escapement on this cycle since 1965. By management group and for this cycle line, spawning escapements in 2017 were the second lowest on record for Early Stuart, lower than average for Early Summer-run, and less than

half the average for Summer and Late-run (Figure 10). There were 515,700 effective female spawners in the Fraser watershed, representing an overall spawning success of 96%.

16. The total run-size estimate of 3,549,200 Fraser River pink salmon was the smallest since 1965 (Figure 11). Catches totalled 157,100 fish, with 37,200 caught by Canada, 102,200 caught by the U.S. and 17,700 caught in test fisheries (Table 7). This catch represents an exploitation rate of 4% (Table 7 and 8), which is the lowest exploitation rate since records began in 1959 (Figure 11).
17. Since 2009, estimates of pink salmon passage have been obtained through the hydroacoustics program at Mission. In 2017, the run size of Fraser River pink salmon was calculated by adding the total catch of pink salmon below Mission (138,900 fish) to the Mission passage estimate (3,410,000 fish, Table 6), while the spawner abundance (3,392,200 fish) was calculated by subtracting the total catch from the run size.

Achievement of Objectives

18. 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.
19. In-season management decisions are based on targets for spawning escapement, which are represented in-season by potential spawning escapement targets (i.e., spawning escapement targets plus MAs). The Panel did not adopt an MA for Early Stuart run as the pre-season forecast abundance indicated fishery decisions would be based on a Low Abundance Exploitation Rate (LAER) of 10%. For the Early Summer run, the spawning escapement target and the addition of the MA also resulted in this group being managed under a LAER. The Summer and Late-run sockeye were also managed under a LAER due to in-season reductions to run size. With the exception of the Early Summer run, the potential spawning escapement targets were equal to the total returns for each group. In-season estimates of potential escapement (i.e., Mission escapement minus all catch above Mission) were 7-13% under the target for all management groups: Early Stuart sockeye (9% under), Early Summer-run (7% under), Summer-run (8% under) and Late-run sockeye (13% under) (Table 10).
20. Spawning ground estimates of Fraser sockeye abundance totalled 940,100 adults, which is 35% below the post-season target. Spawner abundance was severely below target for Early Stuart sockeye (66% under), below target for Early Summer-run (52% under), below target for Summer-run (25% under) and below target for Late-run sockeye (65% under) (Table 11). The exploitation rates for all management groups were less than their respective LAERs (Table 7; LAERS were 10% for all management groups except Late-run for which a 20% LAER was in effect). For Early Stuart, Summer-run and Late-run sockeye, the spawning escapement target equalled the run size, so the escapement target could only be obtained in the absence of catches *and* any difference between estimates. Thus even with the rigorous management approach that was applied in 2017, spawning escapement targets could not be met for any management group.
21. There was no International TAC (Total Allowable Catch) of 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 1,500 Fraser sockeye was more than their 16.5% share. The total Canadian catch of 71,900 Fraser sockeye, which excludes the ESSR catch of Weaver sockeye (which was 0 in 2017) and includes a catch of 100 fish in the Charter test fisheries (Albion and Area 12 Chum) was 700 fish less than the Canadian share of TAC + AFE. In these calculations, the TAC is fixed on the date that Panel control of the last U.S. Panel Area was relinquished (October 7 in 2017), while catches are post-season estimates.
22. In terms of domestic U.S. allocation objectives for Fraser sockeye, Treaty Indian fishers were 1,500 fish above their shares of the U.S. TAC (Table 13).
23. The spawning escapement target for Fraser pink salmon was similar to the post-season target (3% over; Table 11), and the exploitation rate was very low at 4% (Table 7).
24. There was a TAC of 273,200 pink salmon (Table 12) based on the calculation method set out in Annex IV, Chapter 4 of the Pacific Salmon Treaty. The Washington catch of 102,200 Fraser pink salmon was more than their 25.7% share of the international TAC and the Canadian catch of 37,200 was 165,800 fish less than their share.

25. Regarding domestic U.S. allocation objectives for Fraser pink salmon, Treaty Indian and All Citizen fishers were respectively 56,200 fish over and 24,200 under their shares of the U.S. TAC (Table 14).
26. There were no by-catches of non-Fraser sockeye salmon in commercial net fisheries regulated by the Fraser River Panel (Table 15). Catches of other Fraser and non-Fraser salmon species included 2,520 Chinook, 200 coho, and 100 chum.

Allocation Status

27. By Panel agreement there is a U.S. payback of 2,400 Fraser River sockeye to be carried forward to 2018; 900 of which are a carryover from the 2015 season and 1,500 of which were caught in the 2017 season (Table 16). There was no payback owed for Fraser pink salmon (Table 16).

II. FRASER RIVER PANEL

In 2017, the Panel operated under the terms of Annex IV, Chapter 4 of the Pacific Salmon Treaty between Canada and the United States (U.S.)[1]. The Fraser River Panel was responsible for in-season management of fisheries that target Fraser River sockeye and pink salmon within the Panel Area (Figure 1), including 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 and stocks 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 F). The pre-season plan identifies the approximate pattern of fishery openings required to achieve the Panel objectives given pre-season expectations. However, the Panel typically determines the actual pattern of fishery openings based on in-season assessments by PSC staff (Appendix J) of 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 I) works in conjunction with Staff to facilitate Panel activities by providing their

[1] Pacific Salmon Treaty as modified through May 2014.

respective National sections of the Panel with technical advice and ensuring timely exchange of data between Staff and the Parties.

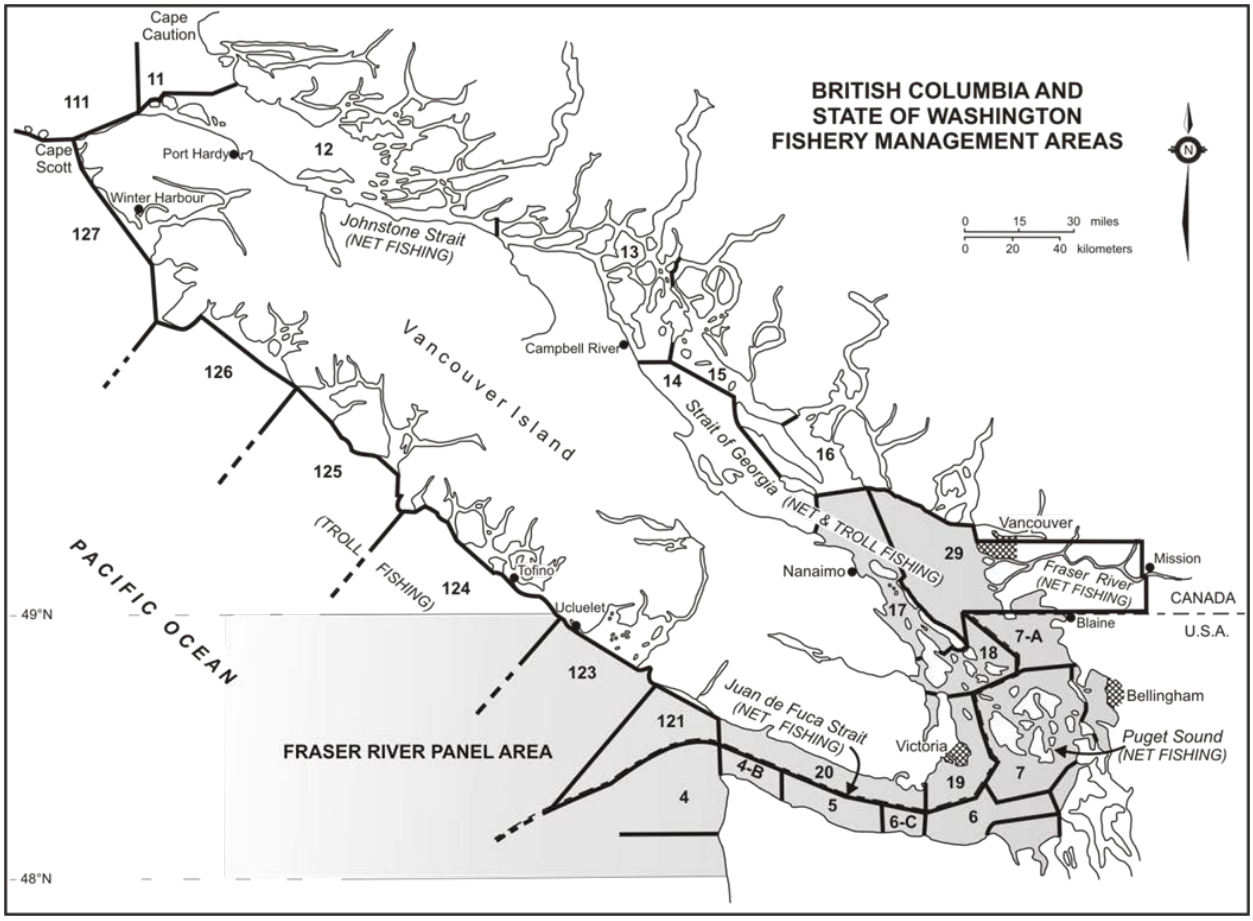

Figure 1. Fishery management areas in the Fraser River Panel Area and south coast waters.

III. PANEL MANAGEMENT ACTIVITIES

Information used for Panel management can be divided into three general categories: (1) pre-season forecasts and expectations, on which planning activities such as the pre-season management plan are based; (2) in-season estimates that change over the course of the season, on which in-season fishery decisions are based; and (3) post-season estimates derived from information that was unavailable during the season, such as spawning ground estimates of escapement, more complete catch estimates, and adjustments to estimates that with hindsight appear to have been biased or incorrect. Post-season estimates impact Panel management in two ways: (a) they can affect the data used to inform pre-season assumptions in future years (e.g. abundance, timing and management adjustments) and (b) some elements (e.g. spawning escapements, catches) impact post-season evaluation of the achievement of management objective (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 Panel Area fisheries were developed by the Panel using the Fishery Planning Model[2], which helps to evaluate the impacts of alternative fishery options on the achievement of management objectives. Model inputs include forecasts of run size, migration timing, diversion rate, Gulf delay, and MAs, as well as test fishery deductions and objectives for spawning escapement and catch allocation.

Both countries evaluated fishing plans that included directed sockeye and pink salmon fisheries. The fisheries targeted mainly Summer-run fish, as well as a smaller number of Early Summer-run fish. The ability of either country to achieve their sockeye TAC was constrained by a 10% low abundance exploitation rate (LAER) applied to Early Stuart sockeye early in the season and 20% LAER for Late run fish later in the season. The LAER is applied to accommodate "small but acceptable" amounts of by-catch for management groups with little or no TAC, as detailed in paragraph 3 (e), Annex IV, Chapter 4 of the Pacific Salmon Treaty[3]. Alternative model runs explored the sensitivity of fishing plans to sockeye salmon run size, and fishing plans were developed based on the p50 sockeye run size as well as the p25 sockeye run size with the pink run size remaining at p50 in both cases. Neither country was able to achieve their allocated TAC for Fraser River pink salmon due to constraints related to the Late-run sockeye abundance and the application of the LAER for that group. During pre-season modelling, fishing induced mortalities (FIMs) for sockeye captured and released during pink-directed fisheries were included in estimates of exploitation rate but excluded from total catch estimates (i.e. not counted against the TAC).

The preliminary run-size forecast for Fraser River sockeye salmon was produced by Canada using a variety of stock-recruit models similar to those analysed in previous years and with data up until the 2009 brood year (2010 brood year for Harrison)[4]. Canada presented the Panel with a sockeye and pink salmon run-size forecast corresponding to five probability levels (10%, 25%, 50%, 75% and 90%) that the return would be below, or at, the specified abundance (Appendix B, Table B1). In 2017, the Panel used the median (i.e., p50 run size) forecast of 4.4 million Fraser River sockeye and 8.7 million Fraser River pink salmon as the "base case" scenario for planning purposes. The Panel also explored an alternative model scenario with a p25 run size for the sockeye return (2.3 million).

Canada used the "Fraser River Sockeye Spawning Initiative" (FRSSI) model to establish escapement goal options for the 2017 management season. The spawning escapement plan released by Canada to the Panel (Appendix B, Table B2) was based on FRSSI guidelines with input from a domestic consultation process. Pre-season escapement targets for sockeye at the p50 run size levels by management group were: Early Stuart – 99,000; Early Summer – 137,000; Summer – 1,375,000; and Lates – 314,000[5]. At this abundance level, the Early Stuart run was managed to a 10% LAER and the Late run was managed to a 20% LAER instead of the associated escapement targets. The pre-season escapement target for pink salmon at the p50 run size level was 6,000,000.

[2] 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.
[3] Pacific Salmon Commission. May 2014. Pacific Salmon Treaty.
[4] DFO. 2017. Pre-season run size forecasts for Fraser River Sockeye (*Oncorhynchus nerka*) salmon in 2017. DFO Can. Sci. Advis. Sec. Sci. Resp. 2017/021.
[5] 2017/2018 Salmon Integrated Fisheries Management Plan Southern BC. Fisheries and Oceans Canada.

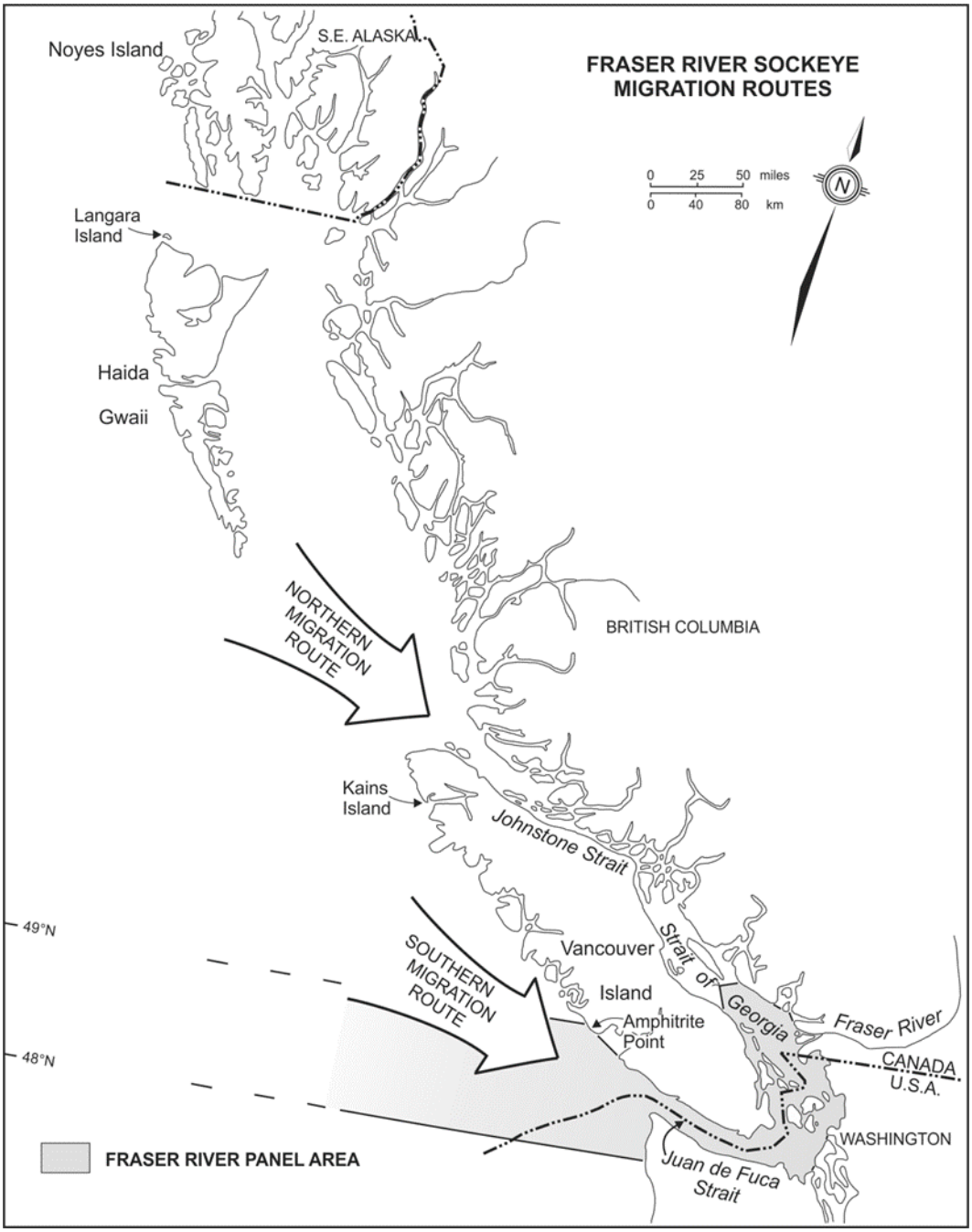

Figure 2. The northern (Johnstone Strait) and southern (Juan de Fuca Strait) routes for sockeye and pink salmon migration to the Fraser River.

Pre-season fisheries management planning was based on assumptions about the proportions of Fraser River sockeye and pink salmon that would migrate through Juan de Fuca Strait versus Johnstone Strait (i.e. Johnstone Strait diversion rate, Figure 2) as well as marine timing (i.e. Juan de Fuca or Area 20 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. The Panel was provided with a timing forecast of June 29th for the Early Stuart run and August 4th for the Chilko run, as generated

by DFOs oceanographic models[4]. June 29th is 5 days earlier than the historical median Early Stuart timing of July 4th, and August 4th is 5 days earlier than the historical median Chilko timing of August 9th. Given the early forecast timing, the Panel decided to adopt median timing minus 4 days for each of the planning model stock groups with the exception of median timing minus 3 days for Early Stuart. An all-years median was applied to Early Stuart and Early Summer sockeye stocks. The median timing for the Summer and Late-run stocks was calculated excluding the earlier-timed 2016 cycle line. The aggregate timing of each management group was then calculated by weighting timing of individual stocks by their p50 run size (or the 2013 brood year abundance in the case of Horsefly and Mitchell). For planning purposes, the Panel adopted weighted average Area 20 dates of July 20th for the Early Summer run, August 6th for Summer-run sockeye and August 14th for Late-run sockeye based on the timing and abundance of component groups. The historic median timing of August 28th was adopted for the pink salmon marine timing in the planning model. Subsequent to the pre-season planning period, DFO also provided a pre-season forecast of pink salmon timing of August 29th.

The Panel adopted a 51% diversion rate for Fraser sockeye through Johnstone Strait based on a forecast using Kains Island May sea surface temperatures and January northward currents from DFOs oceanographic models[6]. The northern diversion rate for Harrison sockeye was calculated as 31% (61% of the diversion forecast for the total sockeye run) based on historical correlations showing a traditionally lower northern diversion. For the purposes of pre-season planning, the diversion rate for pink salmon was calculated as 50% based on the correlation between historical sockeye and pink salmon diversion rates, and adopted by the Panel. Subsequent to the pre-season planning period, DFO also provided a pre-season forecast of pink salmon diversion rate of 46%. Figures 3 and 4 illustrate the distribution of daily abundances for each sockeye management group and for Fraser pink salmon given these pre-season assumptions of Area 20 timing and total run size.

The Panel adopted a 3-day upstream delay for modelling non-Birkenhead Late-run migratory behaviour, corresponding to the all-year median observed delay, and resulting in an August 24th Mission 50% date (i.e. the date 50% of the run has passed Mission) for the overall Late run. The model assumed a 4-day delay for Harrison sockeye (median of all years), resulting in an August 15th Mission 50% date.

DFO's Environmental Watch Program provided the Panel with long-range (3-month) projections of Fraser River temperature and discharge conditions. Forecasts projected near-average water temperatures and discharge for all sockeye management groups. Staff used the environmental forecasts in Management Adjustment (MA) models developed jointly by DFO and the PSC to predict how many additional Early Stuart, Early Summer and Summer-run sockeye should be allowed to escape to increase the probability of achieving spawning escapement objectives (see references in the MA section of the Management Information chapter). The Panel adopted proportional differences between estimates (pDBEs) forecast from the environmental MA models for: the Early Summer run (pDBE=-0.28; pMA = 0.39; MA=53,400 fish), Summer run (pDBE =-0.06; pMA = 0.06; MA=82,500 fish), and the historical odd-year median for the Late run (pDBE = -0.48; pMA = 0.92; MA= 288,900 fish). The Panel did not adopt a pMA for Early Stuart sockeye because the escapement target was equal to the forecast return for that stock group, which meant that a LAER was applied to that group for pre-season modelling. (However, for planning purposes the model was seeded with an Early Stuart pDBE of -0.47 because the pDBE is used by the model to project the number of fish expected to reach the spawning grounds).

At the time of the June meeting, a reduced test fishing program was planned for 2017 due to financial constraints, with later start dates and fewer fisheries than normally scheduled on this

[6] Folkes, Michael J P and Thomson, Richard E and Hourston, Roy A S. (in press). Evaluating Models To Forecast Fraser Sockeye Return Timing And Diversion Rate. DFO Can. Sci. Advis. Sec. Res. Doc.

cycle line. The Naka Creek gillnet test fishery in Area 12, and the gillnet test fishery in U.S. Area 4B/5 were excluded from the calculations. Initial model runs at the June meeting assumed landed catches of 57,000 sockeye and 130,000 pink would be required to cover the costs of this reduced program, and retention of payfish was delayed until August 3rd in all areas in the initial planning model runs. Retention dates and test fishing deductions by management group for the purposes of calculating the TAC were determined by first running the planning model without any competing fisheries to calculate the 'non-discretionary' test fishing catch. The remainder of the test fishing deductions by management group was then distributed among the management groups based on harvestable surplus. Because there was no harvestable surplus, the test fishing deduction for Early Stuart was equivalent to only the non-discretionary catch. There were some differences in the distribution and abundances of landed test fishing catches once additional fisheries were included in the model.

The Panel considered two alternative planning scenarios at the June meeting that included variations in the assumed sockeye salmon run sizes (p50 and p25, with pinks at the p50 level for both). The fishing plan was not finalized until early July, at which point the model was run again at p50 which included a test fishing deduction of 35,000 sockeye and 112,000 pink salmon based on an expected increase to sockeye prices (with retention of payfish delayed until July 31st). Both parties updated their fishing plans based on the finalized input, and adopted the finalized planning model as the "base case" scenario.

Canada and the U.S. developed a management plan under the "base case" conditions described above, including the "2017 Management Plan Principles and Constraints", "2017 Regulations" and "2017 Pre-season Agreement on Test Fishing Deductions" (Appendices C, D and E). Due to conservation concerns, a 3-week moving window closure of fisheries directed at Early Stuart sockeye and 1-week closure of fisheries directed at the early-timed components of the Early Summer run as well as restrictions in place to protect Sakinaw sockeye constrained fishery openings in Canada in the pre-season plan. In the pre-season plan, the first potential salmon fisheries directed at Fraser sockeye commenced on July 17th in U.S. Panel-Area waters. Other than marine FSC fisheries, Canada did not model any sockeye-directed fisheries in Panel-Area waters as part of their pre-season plan. Fisheries directed at Fraser pink salmon were modelled to begin in the fourth week of August for Canada and the first week of September for the U.S. During proposed Individual Transferable Quota (ITQ) fisheries for pink salmon, Canada assumed sockeye non-retention and applied gear-specific FIMs to any sockeye encounters (25% mortality for purse seine, 10% for troll and 60% for gillnet fisheries). The U.S. assumed 25% sockeye mortality in All Citizen pink-directed fisheries (virtually all purse seine catches with much smaller catches in reef net fisheries). Fishing-induced mortalities for released sockeye were not included in catch totals but were incorporated into estimates of total exploitation rate. If in-season assessments indicated that return abundances of sockeye or pink were lower or higher than forecast, that the migration timing of sockeye or pink salmon were substantially different than forecast, or that in-season forecasts of MAs deviated from the pre-season forecasts, then the start dates and duration of planned fisheries could deviate from the proposed plan.

Calculations of TACs and international harvest shares for Fraser sockeye and pink salmon were based on Annex IV, Chapter 4 of the Pacific Salmon Treaty (Appendix C). The pre-season sockeye TAC for international sharing was 1,698,000 (Table 1), of which the 16.5% U.S. (Washington) share was 280,200 fish. The U.S. payback carried over from the previous year was 900 sockeye, leaving 279,300 as the U.S. share. The planning model indicated that, due to the moving window closures to protect the Early Stuart run and components of the Early Summer Run, as well Late-run constraints, it was unlikely that the full TAC could be harvested for the Early Summer and Summer run. Treaty Indian fisheries were allocated 67.6% of the U.S. TAC and All Citizen fishers the remaining 32.4%. The remaining balance to Canada including the 400,000 Aboriginal Fishery Exemption (AFE) was 1,819,000 sockeye. Pre-season catch targets for non-commercial fisheries in Canada totalled 1,094,300 sockeye, including 797,800 fish for in-river First Nations and 280,500 fish for marine First Nations, plus projected recreational catches of 11,100 fish in the Fraser River and 4,900 fish in marine areas. In the commercial sector the overall

target of 763,300 fish was distributed as follows: 48.5% for Area B purse seines, 21.6% for Area D gillnets, 25.1% for Area E gillnets and 4.8% for Area H trollers.

For pink salmon, the pre-season TAC for international sharing was 2,615,300 (Table 1). The U.S. share was 25.7% of the TAC or 672,000 fish, divided equally between Tribal Indian and All Citizen fisheries. The balance to Canada was 74.3% or 1,943,300 fish. Canadian pre-season non-commercial catch targets totalled 183,750 fish, including 73,750 fish for in-river First Nations and 10,000 fish for marine First Nations, plus projected recreational catches of 70,000 fish in the river and 30,000 fish in marine areas. For the commercial sector, Fraser pink catches were distributed as follows: 96.5% for Area B purse seines and 3.5% for Area H trollers.

During the pre-season planning process, both countries identified salmon stocks for which they had conservation concerns and that would influence management decisions for fisheries directed at Fraser River sockeye and pink salmon. Canada identified Chinook from the West Coast of Vancouver Island and the southern Georgia Strait, Fraser Chinook with the exception of the summer 4_1's, interior Fraser River Coho salmon, interior Fraser River steelhead (Thompson and Chilcotin) stocks, Sakinaw sockeye, Nimpkish sockeye, Georgia Strait Coho, and the Southern resident Killer whale population. The U.S. highlighted concerns for Puget Sound Chinook and Coho salmon, Summer-run chum salmon, and the Southern resident Killer whale population.

B. In-season Management

In 2017, all sockeye salmon management groups returned at run sizes that were well below the median pre-season forecasts, and with marine timing later than forecast (Figure 3). Pink salmon also returned at a run size that was well below forecast, but unlike sockeye salmon, the marine timing was much earlier than forecast (Figure 4).

The Fraser River Panel convened 18 times between July 11, 2017 and September 8, 2017 to discuss run status and enact in-season orders (Appendix F) to regulate fisheries directed at Fraser River sockeye and pink salmon in Panel Areas. Table 1 summarizes pre-season and in-season data by management group and by meeting date, including estimates of run size and the various deductions that result in the calculated TAC (ie., 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 last date shown in Table 1 (October 7) is the "TAC date", which is when the Panel relinquished regulatory control of the last U.S. Panel Area and is therefore when the U.S. share of the TAC was established. The main events that transpired each week of the season are summarized below with a focus on Staff assessments and Panel decisions.

Table 1. Pre-season and in-season updates of run size, spawning escapement targets and other TAC-related values for Fraser River sockeye and pink salmon in 2017. 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*										50%
Date		Management Group	Total Abundance	Spawning Escapement Target	pMA	Manage-ment Adjust.	Test Fishing	Aboriginal Fishery Exemption	Total Deductions	Total Allowable Catch	Available Harvest **	Catch to date	Mission Escape. to date	Migration Date Area 20
July 7	Pre-season***	Early Stuart	99,000	99,000	NA	NA	320	9,600	99,000	0	0			1-Jul
		Early Summer	343,000	137,200	0.39	53,500	3,530	25,900	220,130	122,870	148,770			20-Jul
		Summer	3,407,000	1,375,100	0.06	82,500	27,200	347,200	1,832,000	1,575,000	1,922,200			6-Aug
		Late	583,000	314,000	0.92	288,900	3,950	17,300	583,000	0	0			14-Aug
		Sockeye	**4,432,000**	**1,925,300**		**424,900**	**35,000**	**400,000**	**2,734,130**	**1,697,870**	**2,070,970**	**0**	**0**	
		Pink	**8,693,000**	**6,000,000**			**77,700**		**6,077,700**	**2,615,300**	**2,693,000**			28-Aug

Table 1, continued on next page

Table 1, continued

Date		Management Group	Total Abundance	TAC* Spawning Escapement Target	pMA	Manage-ment Adjust.	Test Fishing	Aboriginal Fishery Exemption	Total Deductions	Total Allowable Catch	Available Harvest **	Catch to date	Mission Escape. to date	50% Migration Date Area 20
July 11	In-season	Early Stuart	99,000	99,000	NA	NA	320	9,600	99,000	0	0	120	24,100	1-Jul
		Early Summer	343,000	137,200	0.39	53,500	3,530	25,900	220,130	122,870	148,770	40	3,000	20-Jul
		Summer	3,407,000	1,375,100	0.06	82,500	27,200	347,200	1,832,000	1,575,000	1,922,200	0	0	6-Aug
		Late	583,000	314,000	0.92	288,900	3,950	17,300	583,000	0	0	0	0	14-Aug
		Sockeye	**4,432,000**	**1,925,300**		**424,900**	**35,000**	**400,000**	**2,734,130**	**1,697,870**	**2,070,970**	**0**	**27,100**	
		Pink	**8,693,000**	**6,000,000**			**77,700**		**6,077,700**	**2,615,300**	**2,693,000**	**0**		28-Aug
July 14	In-season	Early Stuart	50,000	50,000	NA	NA	320	4,500	50,000	0	0	190	27,400	3-Jul
		Early Summer	343,000	137,200	0.39	53,500	3,530	26,200	220,430	122,570	148,770	70	6,600	20-Jul
		Summer	3,407,000	1,375,100	0.06	82,500	27,200	351,800	1,836,600	1,570,400	1,922,200	20	820	6-Aug
		Late	583,000	314,000	0.92	288,900	3,950	17,500	583,000	0	0	0	0	14-Aug
		Sockeye	**4,383,000**	**1,876,300**		**424,900**	**35,000**	**400,000**	**2,690,030**	**1,692,970**	**2,070,970**	**280**	**34,820**	
		Pink	**8,693,000**	**6,000,000**			**77,700**		**6,077,700**	**2,615,300**	**2,693,000**	**0**		28-Aug
July 18	In-season	Early Stuart	50,000	50,000	NA	NA	320	4,500	50,000	0	0	370	35,100	3-Jul
		Early Summer	343,000	137,200	0.39	53,500	3,530	26,200	220,430	122,570	152,300	140	11,000	20-Jul
		Summer	3,407,000	1,375,100	0.06	82,500	27,200	351,800	1,836,600	1,570,400	1,949,400	40	1,500	6-Aug
		Late	583,000	314,000	0.92	288,900	3,950	17,500	583,000	0	0	0	0	14-Aug
		Sockeye	**4,383,000**	**1,876,300**		**424,900**	**35,000**	**400,000**	**2,690,030**	**1,692,970**	**2,101,700**	**550**	**47,600**	
		Pink	**8,693,000**	**6,000,000**			**77,700**		**6,077,700**	**2,615,300**	**2,693,000**	**0**		28-Aug
July 21	In-season	Early Stuart	50,000	50,000	NA	NA	320	4,500	50,000	0	0	470	40,000	3-Jul
		Early Summer	343,000	137,200	0.39	53,500	3,530	26,200	220,430	122,570	152,300	160	15,400	20-Jul
		Summer	3,407,000	1,375,100	0.06	82,500	27,200	351,800	1,836,600	1,570,400	1,949,400	60	3,200	6-Aug
		Late	583,000	314,000	0.92	288,900	3,950	17,500	583,000	0	0	0	0	14-Aug
		Sockeye	**4,383,000**	**1,876,300**		**424,900**	**35,000**	**400,000**	**2,690,030**	**1,692,970**	**2,101,700**	**690**	**58,600**	
		Pink	**8,693,000**	**6,000,000**			**77,700**		**6,077,700**	**2,615,300**	**2,693,000**	**0**		28-Aug
July 25	In-season	Early Stuart	50,000	50,000	NA	NA	320	4,500	50,000	0	0	490	43,800	3-Jul
		Early Summer	166,000	137,200	0.39	53,500	3,530	12,970	166,000	0	0	230	18,800	20-Jul
		Summer	3,407,000	1,375,100	0.06	82,500	27,200	364,400	1,849,200	1,557,800	1,949,400	130	4,500	6-Aug
		Late	583,000	314,000	0.92	288,900	3,950	18,130	583,000	0	0	0	0	14-Aug
		Sockeye	**4,206,000**	**1,876,300**		**424,900**	**35,000**	**400,000**	**2,648,200**	**1,557,800**	**1,949,400**	**850**	**67,100**	
		Pink	**8,693,000**	**6,000,000**			**77,700**		**6,077,700**	**2,615,300**	**2,693,000**			28-Aug
July 28	In-season	Early Stuart	50,000	50,000	NA	NA	320	4,500	50,000	0	0	680	43,900	3-Jul
		Early Summer	166,000	137,200	0.39	53,500	3,530	12,970	166,000	0	0	440	25,300	20-Jul
		Summer	3,407,000	1,375,100	0.06	82,500	27,200	364,400	1,849,200	1,557,800	1,949,400	780	11,400	6-Aug
		Late	583,000	314,000	0.92	288,900	3,950	18,130	583,000	0	0	0	0	14-Aug
		Sockeye	**4,206,000**	**1,876,300**		**424,900**	**35,000**	**400,000**	**2,648,200**	**1,557,800**	**1,949,400**	**1,900**	**80,600**	
		Pink	**8,693,000**	**6,000,000**			**77,700**		**6,077,700**	**2,615,300**	**2,693,000**	**10**	**0**	28-Aug
August 1	In-season	Early Stuart	50,000	50,000	NA	NA	320	4,500	50,000	0	0	720	44,600	3-Jul
		Early Summer	166,000	137,200	0.39	53,500	3,530	12,970	166,000	0	0	740	39,500	20-Jul
		Summer	3,407,000	1,375,100	0.06	82,500	27,200	364,400	1,849,200	1,557,800	1,949,400	1,600	35,200	6-Aug
		Late	583,000	314,000	0.92	288,900	3,950	18,130	583,000	0	0	0	0	14-Aug
		Sockeye	**4,206,000**	**1,876,300**		**424,900**	**35,000**	**400,000**	**2,648,200**	**1,557,800**	**1,949,400**	**3,060**	**119,300**	
		Pink	**8,693,000**	**6,000,000**			**77,700**		**6,077,700**	**2,615,300**	**2,693,000**	**350**	**0**	28-Aug
August 4	In-season	Early Stuart	50,000	50,000	NA	NA	320	4,500	50,000	0	0	1,920	45,300	3-Jul
		Early Summer	166,000	137,200	0.39	53,500	3,530	12,970	166,000	0	0	890	52,900	22-Jul
		Summer	3,407,000	1,375,100	0.06	82,500	27,200	364,400	1,849,200	1,557,800	1,949,400	2,500	69,100	6-Aug
		Late	583,000	314,000	0.92	288,900	3,950	18,130	583,000	0	0	100	400	14-Aug
		Sockeye	**4,206,000**	**1,876,300**		**424,900**	**35,000**	**400,000**	**2,648,200**	**1,557,800**	**1,949,400**	**5,410**	**167,700**	
		Pink	**8,693,000**	**6,000,000**			**77,700**		**6,077,700**	**2,615,300**	**2,693,000**	**2,540**	**0**	28-Aug
August 8	In-season	Early Stuart	46,000	46,000	NA	NA	320	4,500	46,000	0	0	1,930	46,000	4-Jul
		Early Summer	125,000	125,000	0.39	48,800	3,530	12,970	125,000	0	0	1,130	67,600	31-Jul
		Summer	3,407,000	1,375,100	0.06	82,500	27,200	364,400	1,849,200	1,557,800	1,949,400	4,070	137,200	6-Aug
		Late	583,000	314,000	0.92	288,900	3,950	18,130	583,000	0	0	200	1,200	14-Aug
		Sockeye	**4,161,000**	**1,860,100**		**420,200**	**35,000**	**400,000**	**2,603,200**	**1,557,800**	**1,949,400**	**7,330**	**252,000**	
		Pink	**8,693,000**	**6,000,000**			**77,700**		**6,077,700**	**2,615,300**	**2,693,000**	**4,760**	**32,200**	28-Aug
August 11	In-season	Early Stuart	46,000	46,000	NA	NA	320	2,600	46,000	0	0	2,430	46,800	4-Jul
		Early Summer	125,000	125,000	0.39	48,800	1,500	10,700	125,000	0	0	1,280	88,200	31-Jul
		Summer	1,250,000	1,250,000	0.06	75,000	10,000	361,000	1,250,000	0	0	6,160	245,400	14-Aug
		Late	583,000	314,000	0.92	288,900	2,000	25,700	583,000	0	0	360	6,100	14-Aug
		Sockeye	**2,004,000**	**1,735,000**		**412,700**	**13,820**	**400,000**	**2,004,000**	**0**	**0**	**10,230**	**386,500**	
		Pink	**8,693,000**	**6,000,000**			**77,700**		**6,077,700**	**2,615,300**	**2,693,000**	**6,050**	**62,200**	28-Aug

Table 1, continued on next page

Table 1, continued

Date		Management Group	Total Abundance	TAC* Spawning Escapement Target	pMA	Manage-ment Adjust.	Test Fishing	Aboriginal Fishery Exemption	Total Deductions	Total Allowable Catch	Available Harvest **	Catch to date	Mission Escape. to date	50% Migration Date Area 20
August 15	In-season	Early Stuart	46,000	46,000	NA	NA	320	2,600	46,000	0	0	2,430	46,700	4-Jul
		Early Summer	125,000	125,000	0.39	48,800	1,500	10,700	125,000	0	0	1,390	100,000	31-Jul
		Summer	1,250,000	1,250,000	0.06	75,000	10,000	361,000	1,250,000	0	0	8,190	382,600	14-Aug
		Late	583,000	314,000	0.92	288,900	2,000	25,700	583,000	0	0	610	20,100	14-Aug
		Sockeye	**2,004,000**	**1,735,000**		**412,700**	**13,820**	**400,000**	**2,004,000**	**0**	**0**	**12,620**	**549,400**	
		Pink	**8,693,000**	**6,000,000**			**77,700**		**6,077,700**	**2,615,300**	**2,693,000**	**5,450**	**139,600**	28-Aug
August 18	In-season	Early Stuart	46,000	46,000	NA	NA	320	4,180	46,000	0	0	2,570	46,400	4-Jul
		Early Summer	150,000	137,000	0.39	53,400	1,500	13,400	150,000	0	0	1,750	128,900	2-Aug
		Summer	1,250,000	1,250,000	0.06	75,000	10,000	114,400	1,250,000	0	0	15,600	495,300	14-Aug
		Late	247,000	247,000	0.92	227,200	2,000	47,300	247,000	0	0	930	37,300	18-Aug
		Sockeye	**1,693,000**	**1,680,000**		**355,600**	**13,820**	**179,280**	**1,693,000**	**0**	**0**	**20,850**	**707,900**	
		Pink	**8,693,000**	**6,000,000**			**77,700**		**6,077,700**	**2,615,300**	**2,693,000**	**8,440**	**180,800**	28-Aug
August 22	In-season	Early Stuart	46,000	46,000	NA	NA	320	4,180	46,000	0	0	2,570	46,400	4-Jul
		Early Summer	150,000	137,000	0.39	53,400	1,500	13,400	150,000	0	0	2,290	143,100	2-Aug
		Summer	1,250,000	1,250,000	0.06	75,000	10,000	114,400	1,250,000	0	0	22,760	732,000	14-Aug
		Late	247,000	247,000	0.92	227,200	2,000	47,300	247,000	0	0	3,400	60,200	18-Aug
		Sockeye	**1,693,000**	**1,680,000**		**355,600**	**13,820**	**179,280**	**1,693,000**	**0**	**0**	**31,020**	**981,700**	
		Pink	**8,693,000**	**6,000,000**			**77,700**		**6,077,700**	**2,615,300**	**2,693,000**	**22,870**	**213,500**	28-Aug
August 25	In-season	Early Stuart	46,000	46,000	NA	NA	320	4,180	46,000	0	0	2,730	46,400	4-Jul
		Early Summer	150,000	137,000	0.39	53,400	1,500	13,400	150,000	0	0	2,870	153,500	2-Aug
		Summer	1,000,000	1,000,000	0.06	60,000	10,000	114,400	1,000,000	0	0	41,280	848,100	11-Aug
		Late	247,000	247,000	0.92	227,200	2,000	47,300	247,000	0	0	4,070	66,200	18-Aug
		Sockeye	**1,443,000**	**1,430,000**		**340,600**	**13,820**	**179,280**	**1,443,000**	**0**	**0**	**50,950**	**1,114,200**	
		Pink	**8,693,000**	**6,000,000**			**77,700**		**6,077,700**	**2,615,300**	**2,693,000**	**26,690**	**317,200**	28-Aug
August 28	In-season	Early Stuart	46,000	46,000	NA	NA	320	4,180	46,000	0	0	2,730	46,400	4-Jul
		Early Summer	150,000	137,000	0.39	53,400	1,500	13,400	150,000	0	0	2,900	157,300	2-Aug
		Summer	1,000,000	1,000,000	0.06	60,000	10,000	114,400	1,000,000	0	0	41,880	894,300	11-Aug
		Late	247,000	247,000	0.92	227,200	2,000	47,300	247,000	0	0	4,490	78,200	18-Aug
		Sockeye	**1,443,000**	**1,430,000**		**340,600**	**13,820**	**179,280**	**1,443,000**	**0**	**0**	**52,000**	**1,176,200**	
		Pink	**4,800,000**	**4,310,400**			**77,700**		**4,388,100**	**411,900**	**489,600**	**35,890**	**569,900**	24-Aug
August 31	In-season	Early Stuart	46,000	46,000	NA	NA	320	4,180	46,000	0	0	2,750	46,400	6-Jul
		Early Summer	150,000	137,000	0.39	53,400	1,500	13,400	150,000	0	0	3,240	161,000	31-Jul
		Summer	1,000,000	1,000,000	0.06	60,000	10,000	114,400	1,000,000	0	0	54,680	940,100	12-Aug
		Late	247,000	247,000	0.92	227,200	2,000	47,300	247,000	0	0	4,960	93,000	23-Aug
		Sockeye	**1,443,000**	**1,430,000**		**340,600**	**13,820**	**179,280**	**1,443,000**	**0**	**0**	**65,630**	**1,240,500**	
		Pink	**4,800,000**	**4,310,400**			**77,700**		**4,388,100**	**411,900**	**489,600**	**39,390**	**785,100**	24-Aug
September 5	In-season	Early Stuart	46,000	46,000	NA	NA	320	4,180	46,000	0	0	2,750	46,400	6-Jul
		Early Summer	150,000	137,000	0.39	53,400	1,500	13,400	150,000	0	0	3,250	161,900	31-Jul
		Summer	1,000,000	1,000,000	0.06	60,000	10,000	114,400	1,000,000	0	0	55,820	995,600	12-Aug
		Late	247,000	247,000	0.92	227,200	2,000	47,300	247,000	0	0	5,400	125,300	23-Aug
		Sockeye	**1,443,000**	**1,430,000**		**340,600**	**13,820**	**179,280**	**1,443,000**	**0**	**0**	**67,220**	**1,329,200**	
		Pink	**4,500,000**	**4,069,700**			**50,000**		**4,119,700**	**380,300**	**430,300**	**127,500**	**1,378,700**	23-Aug
September 8	In-season	Early Stuart	47,000	47,000	NA	NA	320	4,180	47,000	0	0	2,780	46,400	4-Jul
		Early Summer	165,000	137,000	0.39	53,400	1,500	13,400	165,000	0	0	3,330	161,900	4-Aug
		Summer	1,044,000	1,044,000	0.06	62,600	10,000	114,400	1,044,000	0	0	63,740	1,009,900	11-Aug
		Late	231,000	231,000	0.92	212,500	2,000	47,300	231,000	0	0	6,370	139,400	16-Aug
		Sockeye	**1,487,000**	**1,459,000**		**328,500**	**13,820**	**179,280**	**1,487,000**	**0**	**0**	**76,220**	**1,357,600**	
		Pink	**3,700,000**	**3,409,100**			**20,000**		**3,429,100**	**270,900**	**290,900**	**139,510**	**1,817,500**	19-Aug
October 7	TAC Date	Early Stuart	47,000	47,000	NA	NA	320	4,180	47,000	0	0	2,790	46,500	4-Jul
		Early Summer	165,000	137,000	0.39	53,400	1,500	13,400	165,000	0	0	3,320	161,300	4-Aug
		Summer	1,044,000	1,044,000	0.06	62,600	10,000	114,400	1,044,000	0	0	71,930	1,044,700	11-Aug
		Late	231,000	231,000	0.92	212,500	2,000	47,300	231,000	0	0	6,820	205,300	16-Aug
		Sockeye	**1,487,000**	**1,459,000**		**328,500**	**13,820**	**179,280**	**1,487,000**	**0**	**0**	**84,860**	**1,457,800**	
		Pink	**3,700,000**	**3,409,100**			**20,000**		**3,429,100**	**270,900**	**290,900**	**158,750**	**3,477,600**	19-Aug

Table 1, continued on next page

Table 1, continued.

Date	Management Group	Total Abundance	TAC* Spawning Escapement Target	pMA	Manage-ment Adjust.	Test Fishing	Aboriginal Fishery Exemption	Total Deductions	Total Allowable Catch	Available Harvest **	Catch to date	Mission Escape. to date	50% Migration Date Area 20
Post-season****	Early Stuart	46,000	46,000	NA	NA	320	4,180	46,000	0	0	2,920	45,700	4-Jul
	Early Summer	160,900	137,000	0.39	53,400	1,400	13,400	160,900	0	0	3,360	155,000	4-Aug
	Summer	1,056,600	1,056,600	0.06	63,400	10,200	114,400	1,056,600	0	0	73,960	1,017,300	12-Aug
	Late	217,500	217,500	0.92	200,100	1,900	47,300	217,500	0	0	6,760	203,500	17-Aug
	Sockeye	**1,481,000**	**1,457,100**		**316,900**	**13,820**	**179,280**	**1,481,000**	**0**	**0**	**87,000**	**1,421,500**	12-Aug
	Pink	**3,549,200**	**3,281,500**			**17,700**		**3,299,200**	**250,000**	**267,700**	**157,070**	**3,410,000**	18-Aug

* The TAC is determined by the run sizes and TAC deductions (spawning escapement targets, management adjustments, projected test fishing catches and AF Exemptions) that were in effect when Panel control of the last U.S. fishery area was relinquished (Oct 7).

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

*** 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.

**** Mission escapement estimates decreased slightly (by 2%) due to small correction to estimates from the mobile system.

July 09 - 15, 2017:

The first in-season Panel meeting took place on Tuesday, July 11. Due to favourable river conditions the Mission hydroacoustics program was operational on July 07, three days earlier than expected. Only a small number of sockeye had been caught in the marine and in-river test fisheries. In marine areas, 40-60% of the sockeye caught were non-Fraser sockeye. The Fraser component consisted predominantly of Early Stuart. On July 14, the Panel decreased the Early Stuart run size to 50,000 with a 50% marine timing through Area 20 of July 03. The Fraser River water temperature at Qualark was 17.0°C and the discharge was 4,693 $m^3 \cdot s^{-1}$.

July 16 – 22, 2017:

Marine test fisheries indicated a very low migration of Fraser River sockeye through marine assessment areas. The Early Stuart run migration through the marine approach areas was winding down. The reconstructed marine abundance for Early Summer run through July 20 (the expected 50% migration date for Early Summer-run) totalled only 25,000 sockeye. The Chilliwack run was tracking well below the p25 forecast of 28,000 fish. Early Summer-run daily abundance estimates were also tracking below abundances consistent with a p25 forecast of 166,000 fish. Due to the low daily abundance levels estimated for the Early Summer-run group, no sockeye-directed fisheries were planned by either country. The diversion rate continued to be low at 16%. Flow levels continued to decrease while temperature stayed fairly constant for the week. The Fraser River water temperature at Qualark was 17.3°C and the discharge was low at 3,784$m^3 \cdot s^1$.

July 23 – 29, 2017:

On July 28, the Early Stuart run was close to completion with an estimated catch plus escapement of 44,600, while daily abundances of the Early Summer run continued to be low, resulting in an estimated catch plus escapement of 25,700 sockeye eight days after the expected 50% migration date of July 20. On July 25, the Panel agreed to adopt the p25 forecast of 166,000 as an interim management measure, which had the effect of eliminating any total allowable catch (TAC) for the Early Summer run management group.

Based on reconstructed abundances, the timing of Early Stuart matched the historic median timing of July 4. In addition, Early Summer-run timing estimates appeared close to the historic median timing of July 29. As a result, the timing for Summer-run and Late-run were also expected to be near historical median timing estimates, August 8 and August 16, respectively. The diversion

rate increased to 32%. The Fraser River water temperature at Qualark was 18.6°C and the discharge was low at 3,280$m^3 \cdot s^1$. The discharge was predicted to decrease further to historic minimum discharge levels, while the temperatures were predicted to reach values near the historic maximum temperatures for the time of year by the end of the forecast period. Since both the Early Stuart (based on its escapement target being equal to the run size) and the Early Summer run (based on the combination of its escapement target and the pre-season management adjustment) were managed under a LAER, the temperature and discharge estimates were not used to provide preliminary predictions of the in-season Management Adjustments for these groups. Instead, full 31-day predictions of the expected proportional differences between estimates (pDBEs) would be provided when available.

July 30 – August 05, 2017:

As of August 4, the Early Stuart run was nearly complete with an estimated catch plus escapement of 45,500. Daily abundances of Early Summer-run continued to be low, totalling 53,700 sockeye. The Pitt component made up the majority of the Early Summer run and was timed later than the majority of the historic years. The uncertainty around the timing of the Pitt component and the associated run size caused uncertainty regarding the Early Summer-run run size which was estimated to fall between the p10 forecast (95,000) and the p25 forecast (166,000). The daily abundances of Summer-run were tracking at abundance levels well below the pre-season p50 forecast (3,407,000) and much closer to the p10 forecast (1,065,000). To date, the estimated escapement and catch past Mission of Summer-run sockeye was 71,500 fish. Given the limited number of Summer-run observed thus far, the run would need to be timed later than August 15 in order to reach the p25 forecast. Only a few Late-run sockeye were estimated to have passed the marine assessment areas.

The diversion rate increased to 58%. The Fraser River water temperature at Qualark was 18.6°C and the discharge was low at 2,870$m^3 \cdot s^1$. The combination of extreme air temperatures and extremely low river discharge resulted in extreme river temperature forecasts (20.0°C), but previous forecasts of high river temperature had not materialized, due to the extensive smoke cover from wildfires that had been occurring throughout the province.

August 06 – 12, 2017:

Catch and escapements remained low, totalling 393,300 sockeye on August 10. On August 8, the Panel adjusted the in-season run-size estimate for the Early Stuart run to 46,000 with a 50% marine timing through Area 20 of July 4 and also adopted an in-season run-size estimate for the Early Summer run (consisting predominantly of sockeye from the Pitt River) of 125,000 with a 50% marine timing through Area 20 of July 31. On August 11, the Panel agreed to adopt a run size for the Summer-run of 1,250,000 with a 50% marine timing of August 14.This eliminated the total allowable catch (TAC) for the Summer-run component and triggered the implementation of a low abundance exploitation rate (LAER) limit of 10% for this group. For Late-run sockeye, the catch plus escapement through August 10 was 6,500. Based on pre-season forecast estimates and Late-run abundances observed to date, there were no expectations that the Late-run abundance would increase to the level needed to change the current LAER limit of 20%.

The estimated diversion rate of sockeye salmon had increased to 75%. As of August 10, the Fraser River water discharge at Hope was 2,740$m^3 \cdot s^{-1}$ with a water temperature at Qualark of 19.5°C. The 31-day model predicted an expected proportional difference between estimates (pDBE) of -32% for Early Stuart while the 19-day model predicted a pDBE of –48% for Early Summer-run excluding Pitt and Chilliwack compared to pre-season expectations of -47% and -27%, respectively.

Based on purse seine test fishery data, the number of Fraser River pink salmon migrating through marine areas totalled 928,000 as of August 10. In-river estimates of pink salmon were

generated by the Mission hydroacoustics program. As of August 10, 62,200 pink salmon had migrated past Mission. The pink salmon diversion rate started high at 86%.

August 13 – 19, 2017:

Catch and escapements remained low, totalling 717,600 sockeye salmon on August 17. Daily abundances of Early Summer run continued to be quite low. Based on the latest DNA sample from Area 20, the Early Summer run had nearly completed its migration through marine areas and the Panel adopted an increased run-size estimate of 150,000 with a 50% marine timing through Area 20 of August 2. The daily abundances of Summer-run continued to be close to abundances associated with the p10 forecast (1,065,000). Daily abundances of Late-run sockeye were well below levels corresponding to the pre-season forecast of 583,000, and on August 18, the Panel agreed to adopt a provisional Late-run in-season estimate of 247,000 (p25 forecast) with a 50% marine timing of August 18.

The sockeye diversion rate continued its increase to 78%. As of August 17, the Fraser River water discharge at Hope was 2,505 $m^3 \cdot s^{-1}$ with water temperature at Qualark reading 19.0ºC. The 19-day model predicted an expected proportional difference between estimates (pDBE) of -50% for Early Summer-run excluding Pitt and Chilliwack and which resulted in a weighted pDBE of -26% for Early Summer run aggregate compared to pre-season expectations of -27% and -28%, respectively.

The Fraser River pink salmon daily abundances appeared to be higher than abundances associated with the median pre-season forecast (8,693,000). It was unknown if the increase in abundance was due to early timing or if it was indicative of a large run size. In-river estimates of pink salmon were generated by the Mission hydroacoustics program, and as of August 17, 180,800 were estimated to have passed the Mission site. At 44%, the pink salmon diversion rate was much lower than the previous week.

August 20 – 26, 2017:

Catch and escapements remained low, totalling 1,135,000 sockeye salmon on August 24. About 92,000 sockeye were expected to pass Mission in the next 6 days and about 13% of the run (187,000 sockeye) was predicted to be seaward of the marine test fishing sites, most of which would be Summer-run and Late-run fish. This would result in a total run size for Fraser sockeye of 1,458,000 salmon. On August 25, the Panel agreed to reduce the run size for the Summer-run to 1,000,000 with a 50% marine timing of August 11.

The sockeye diversion rate decreased slightly to 72%. As of August 24, the Fraser River water discharge at Hope was 2,088 $m^3 \cdot s^{-1}$ with water temperature at Qualark reading 18.6ºC. The 19-day model predicted an expected proportional difference between estimates (pDBE) of -25% for Summer-run excluding Harrison compared to pre-season expectations of -4%.

The Fraser River pink salmon daily abundances now appeared to be lower than abundances associated with the median pre-season forecast (8,693,000). As of August 24, 343,500 were estimated to have passed the Mission site. At 37%, the pink salmon diversion rate continued to decrease from the previous week.

No commercial fisheries were planned for sockeye, but because of the low sockeye encounter rate along the Juan de Fuca migration route (2%) fisheries directed at pink salmon began in U.S. waters earlier in the week. A Treaty Indian Fishery was opened for Areas 4b, 5, 6C for drift gillnets but no vessels went fishing in this area. A small group meeting occurred August 24 and other openings were permitted for the remainder of the week and over the weekend. As of Friday August 25, 11,693 pink salmon had been caught in a Treaty Indian commercial fishery in Areas

6,7,7A and a total of 392 sockeye salmon had been caught and kept for ceremonial & subsistence purposes.

August 27 – September 02, 2017:

Starting on August 25, the sockeye escapement past Mission was estimated using Whonnock CPUE data and as of August 30, the catch and escapements totaled 1,240,500. The change in methodology used to estimate sockeye salmon escapement (from the length based mixture model to the CPUE-based estimates) occurred on August 28 and was applied retroactively back to August 25, when several indicators of pink salmon abundance (fish wheel catch, increased in-river catch of pink salmon, and increased traces in the sonar echograms at Mission) all indicated that the abundance of pink salmon might be underestimated by length-based mixture model (and as a consequence might be overestimating sockeye salmon). The revision in daily sockeye abundances did not impact the in-season run size estimates which remained the same.

The sockeye salmon diversion rate increased to 97%. As of August 30, the Fraser River water discharge at Hope was 2,025 $m^3 \cdot s^{-1}$ with water temperature at Qualark reading 18.4ºC.

The Fraser River pink salmon daily abundances continued to be lower than abundances associated with the median pre-season forecast (8,693,000), and as of August 30, 785,000 were estimated to have escaped past Mission. The daily pink salmon migration showed a peak in daily abundance around August 15 and traditional run size models assuming a normal distribution confirmed this as the 50% migration date. Because this timing estimate is 4 days earlier than the timing in 1961 (19 August) which is the earliest on record (1959-2015), and because insufficient data had been available to rule out later timing, an alternative run size model relating the total CPUE of the four days prior to the historic peak migration date (28-Aug) was used to estimate the pink salmon run size. On Monday, August 28, the Panel adopted a pink salmon run size of 4,800,000 with a 50% marine timing of August 24 based on this run size model. At 72%, the pink salmon diversion rate had increased substantially from the previous week (37%).

Commercial fisheries directed at Fraser River pink salmon continued for both Treaty Indian and All Citizen fishers in U.S. Panel waters. It was noted at the meeting on August 31 that some boats were targeting farmed Atlantic salmon, which had escaped from an aquaculture facility the week before. As a result, the effort directed at pink salmon fisheries was not as great as had been anticipated. Pink and sockeye salmon by-catch from the Atlantic salmon fishery was reported in the catch estimates to the PSC. As of Friday, September 1, 500 sockeye and 170 pink salmon had been caught in a Ceremonial & Subsistence fishery in Areas 6,7,7A, a total of 4,500 pink salmon were caught in an All Citizen fishery without retention of sockeye salmon, and 31,000 pink salmon were caught in a Treaty Indian fishery. All ongoing U.S. fisheries were extended until September 5.

September 03 - 09, 2017:

Fraser River sockeye salmon migration was nearly complete. Test fisheries in marine areas concluded for the season, while gillnet test fisheries in the Fraser River continued. As of September 8, the estimated catch plus escapement of Fraser River sockeye was 1,382,100. Assessments indicated that a portion (35%) of the remaining Late-run sockeye salmon in marine areas were delaying. Because September 8 was the final in-season Panel meeting, the Panel adopted the following run sizes and marine timing estimates for the four management groups: Early Stuart-run run size of 47,000 with a marine timing of July 4; Early Summer-run run size of 165,000 with a marine timing of August 4; Summer-run run size of 1,044,000 with a marine timing of August 11 and Late-run run size of 231,000 with a marine timing of August 16. The sockeye salmon diversion rate decreased to 85%. As of September 8, the Fraser River discharge at Hope was 1,884$m^3 \cdot s^{-1}$ with water temperature at Qualark reading 18.1ºC.

On September 5, the Panel discussed at length the Fraser River pink salmon run size. Estimating pink salmon run size was challenged by the fact that in-season estimates of catch plus escapement does not provide in-season feedback on catchability estimates used to relate marine CPUE data to daily abundance estimates. Also, pink salmon migrate slower than sockeye salmon and may be delaying their entry into the Fraser River which further delays any confirmation of marine abundance estimates. Given the low marine daily abundance estimates to date and uncertainty regarding possible pink salmon abundance seaward of marine test fisheries, the Panel took the precautionary measure to reduce the pink salmon run size to 4,500,000 with a marine timing of August 23. This run size estimate was based on historic estimates (1987-2015) of the percent of the run seaward of the marine test fisheries left to come. The run size reduction removed any available U.S. TAC for pink salmon. At the meeting on September 8, the Panel further reduced the run size to 3,700,000 with a marine timing of August 19. The pink salmon timing estimate was derived using the traditional pink salmon run size model assuming changes in daily pink salmon abundances follow a normal distribution and the associated run size was derived by doubling the total reconstructed marine abundance up to that date. The estimated escapement of pink salmon past Mission through September 7 was 1,817,500 fish. The pink salmon diversion rate remained high at 84%.

On September 3 at 11:59 p.m., all commercial U.S. fisheries directed at pink salmon were terminated prematurely due to better than expected catches. Although no sockeye salmon TAC was available, the by-catch from the pink salmon directed fishery resulted in a catch of 1,500 sockeye salmon which were retained for Ceremonial & Subsistence purposes.

On October 7, Panel control of the last U.S. Panel Area was relinquished, in accordance with the pre-season regulations. The inputs used to calculate the TAC and international shares were frozen on this date (except for post-season updates to the test fishery catch deduction), according to the revised Annex IV, Chapter 4 of the Pacific Salmon Treaty. The achievement of these in-season catch objectives will be assessed by comparison with post-season catch estimates in the Achievement of Objectives section of this report.

Overviews of commercial fisheries openings in U.S. Panel Areas are contained in Table 2. There were no commercial fisheries in Canadian Panel Areas.

Table 2. Number of days when major U.S. net fisheries in the Fraser River Panel Area were open for directed harvest of Fraser River sockeye and pink salmon in 2017. Regulatory control of U.S. Panel Areas was relinquished by the Panel on September 16 for Areas 4b, 5 and 6c, September 24 for Areas 6, 7 and portions of 7a (according to in-season orders), and October 7 for the remaining portions of Area 7a, in accordance with pre-season regulations (Appendix D).

	Treaty Indian		All Citizen		
	Areas	Areas	Areas 7 and 7A		
Date	4B, 5, 6C	6, 7, 7A	Purse Seine	Gillnet	Reefnet
Jun.4-Jul.22					
Jul.23-Jul.29					
Jul.30-Aug.5					
Aug.6-Aug.12					
Aug.13-Aug.19					
Aug.20-Aug.26	4	4			2
Aug.27-Sep.2	5	5	3	3	4
Sep.3-Sep.9	3	1	1	1	1
Sep.10-Sep.16					
Sep.17-Sep.23					
Total	12	10	4	4	7

IV. MANAGEMENT INFORMATION

To facilitate decision making, the Panel requires information about the abundance, timing, migration route and 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 G). 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 3. 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 4 shows the sockeye stock resolution that was reported in 2017.

Table 3. Panel-approved stock monitoring operations (test fishery, hydroacoustic and observer) conducted during the 2017 fishing season.

Area	Location	Gear	Dates	Operated by
Canadian Panel Areas				
20	Juan de Fuca Str.	Gillnet	July 7 - August 10	PSC
20	Juan de Fuca Str.	Purse Seine	July 25 - September 7	PSC
29-14	Fraser R. (Cottonwood)	Gillnet	July 12 - September 10	PSC
29-16	Fraser R. (Whonnock)	Gillnet	June 28 - September 30	PSC
29-16	Fraser R. (Mission)	Hydroacoustic	July 7 - September 25	PSC
	Fraser R. (Qualark)	Gillnet	July 2 - September 24 [3]	DFO
	Fraser R. (Qualark)	Hydroacoustic	July 1 - September 24 [3]	DFO
	Fraser R. (Hells Gate)	Observer	July 3 - September 24	PSC
Canadian non-Panel Areas				
12	Queen Charlotte Str. (Round Is.)	Gillnet	July 11 - August 13	DFO
12	Johnstone Str. (Blinkhorn)	Purse Seine	July 24 - September 6	DFO
13	Lower Johnstone Str.	Purse Seine	July 31 - August 14	DFO
United States Panel Areas				
7	San Juan Islands	Reefnet	July 22 - July 24	PSC

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

summarized how these estimates changed each week as data from the programs accumulated. The following sections provide a summary of the end-of-season results.

Table 4. Individual stocks included in the Fraser River sockeye stock groups used in 2017.

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

A. Abundance

Final in-season estimates of run-size adopted by the Panel totalled 1,487,000 Fraser River sockeye and 3,700,000 pink salmon (Table 1). This much lower -than-forecasted abundance constrained fishing opportunities in both countries. The post-season abundance estimate for sockeye salmon (1,471,200 fish, Tables 7 and 8) based on accounted catches, spawning ground enumerations and difference between estimates is slightly lower than the end-of-season estimate, and 67% lower than the pre-season median forecast (4,432,000).

Ongoing research at Mission[7],[8] has produced hydroacoustic methods that provide reliable estimates of pink salmon passage during periods in September when high numbers of pink salmon migrate. The post season run-size estimate of 3,549,200 fish (Table 7) was calculated by adding the estimated catch below Mission (138,900 fish) to the Mission passage estimate (3,410,000 fish, Table 6). This estimate is 59% lower than the median pre-season forecast (8,693,000).

[7] Xie, Y., F.J.Martens, and J.L.Nelitz. 2012. Implementation of stationary sub-sampling systems to estimate salmon passage in the Lower Fraser River: Year 1 of 2011 and 2012 project report to Southern boundary restoration and enhancement fund. Pacific Salmon Commission, Vancouver, British Columbia. May, 2012.
[8] Martens, F.J. and Y.Xie. 2014. Estimation of near-shore salmon passage using stratified vertical sampling by DIDSON sonar: A final project report to the southern boundary restoration and enhancement fund. Pacific Salmon Commission. June, 2014.

B. Migration Timing and Diversion Rate

Figures 3 and 4 show the forecasted and observed daily migrations, and Area 20 50% migration dates for each sockeye management group and for total Fraser sockeye and pink salmon. The end-of-season estimates of marine migration timing in 2017 were later than pre-season expectations for the Early Stuart (3 days later), Early Summer-run (15 days later), Summer-run (6 days later) and Late-run (3 days later) groups but earlier than expected for pink salmon (10 days earlier). Excluding Summer-run, the timing of the sockeye stocks was similar to the cycle line average. The timing for pink salmon was the earliest on record since 1959 and only one day later than the timing of the Late-run sockeye.

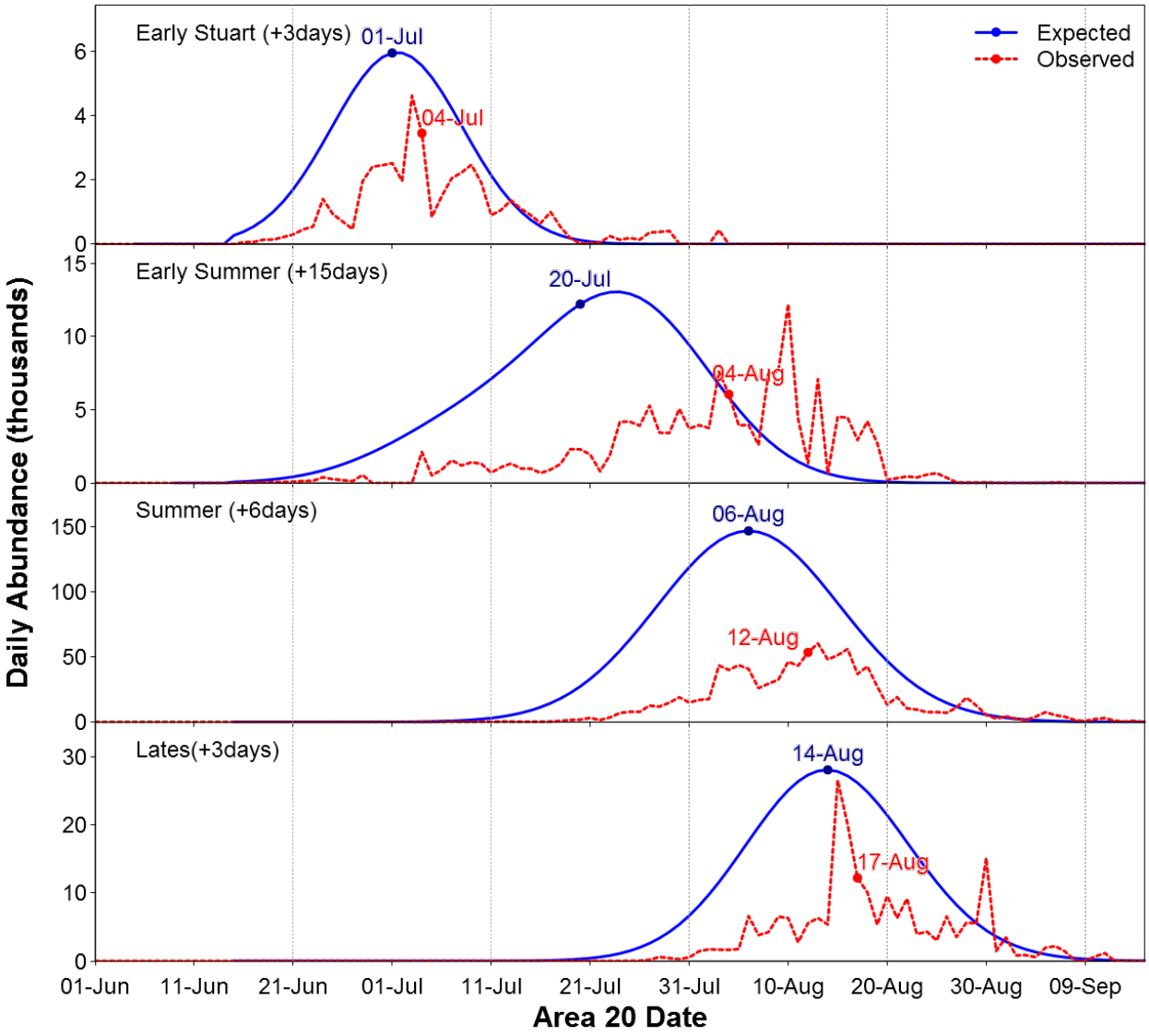

Figure 3. Pre-season projections and post-season reconstructions of daily Fraser River sockeye salmon abundance by management group in 2017 (Area 20 date), including the observed 50% dates and number of days difference with pre-season expectations.

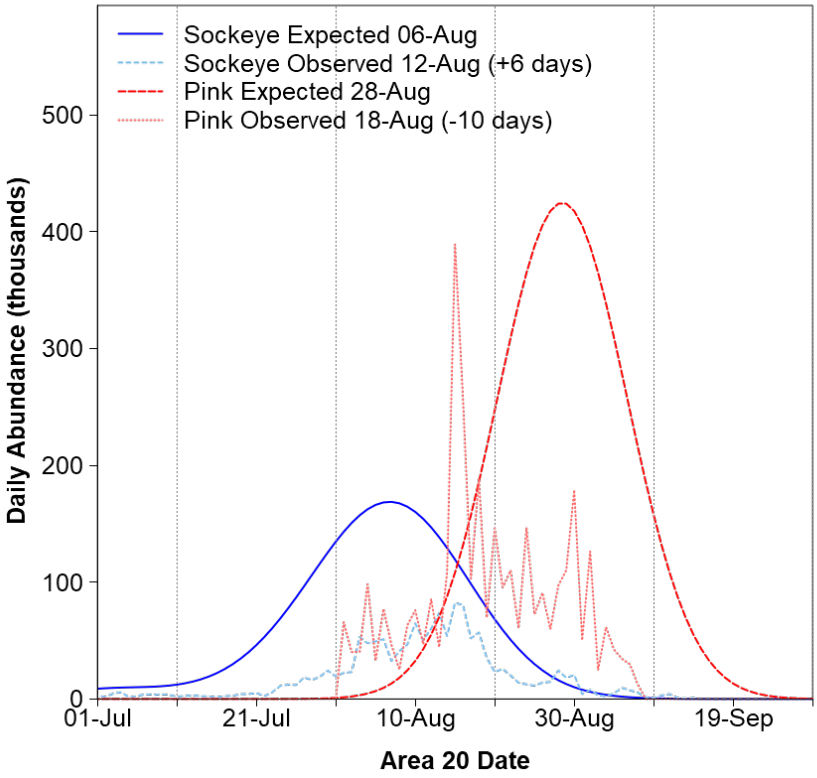

Figure 4. Pre-season projections and post-season reconstructions of daily Fraser River sockeye and pink salmon abundance in 2017 (Area 20 date), including the observed 50% dates and number of days difference with pre-season expectations.

Diversion rates in 2017 were higher than forecast for both Fraser sockeye and pink salmon. The observed annual diversion through Johnstone Strait was 71% of the Fraser sockeye return, compared to the initial forecast of 51% used for pre-season planning (Figure 5). For Fraser River pink salmon, the Johnstone Strait diversion rate was 57% instead of the 50% that was used in planning and the forecasted value of 46%.

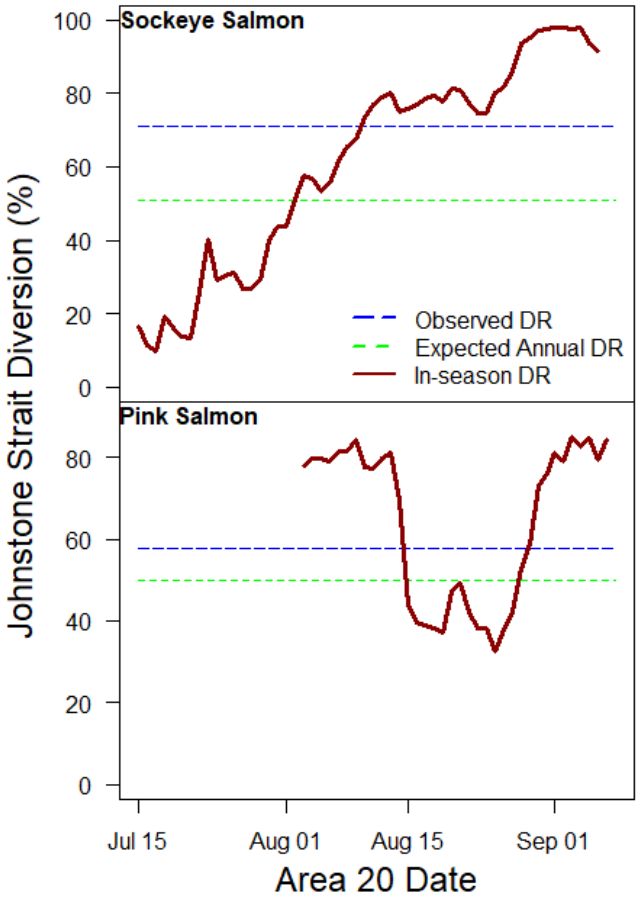

Figure 5. Pre-season forecasts of annual Johnstone Strait diversion rate (DR) for Fraser sockeye and pink salmon, compared to observed short-term and annual rates.

C. Management Adjustments and DBEs

Management Adjustments (MAs) are based on statistical models [9,10,11,12] 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). For Early Stuart, Early Summer-run and Summer-run stocks, the models relate historical escapement differences (difference between estimates, or DBEs) to river conditions measured near Hope, BC in the Fraser River. When discharge levels or

[9] Hague, M.J., and Patterson, D.A. 2007. Quantifying the sensitivity of Fraser River sockeye salmon (*Oncorhynchus nerka*) Management Adjustment models to uncertainties in run timing, run shape and run profile. Can. Tech. Rep. Fish. Aquat. Sci. 2776 : vii + 55p.

[10] Macdonald, J.S., Patterson, D.A., Guthrie, I., Lapointe, M. 2008. Improvements to environmental Management Adjustment models: SEF final report.

[11] Macdonald, J.S., Patterson, D.A., Hague, M.J., Guthrie, I.C. 2010. Modeling the Influence of Environmental Factors on Spawning Migration Mortality for Sockeye Salmon Fisheries Management in the Fraser River, British Columbia. Transactions of the American Fisheries Society 139:768-782.

[12] Cummings, J.W., Hague, M.J., Patterson, D.A., and Peterman, R.M. 2011. The impact of different performance measures on model selection for Fraser River sockeye salmon. N. Am. J. Fish. Aquat. Sci. 31: 323-334.

temperatures are above average, DBEs also tend to be higher than average. In addition, for Early Stuart and Early Summer runs, in-season estimates are consistently higher than spawning ground estimates even when migration conditions are within normal ranges, and this tendency is also captured by the MA models. For Late-run sockeye, historical DBEs are related to the date when half the run has migrated past Mission (i.e., Mission 50% date), which captures the impact of the early migration behaviour observed since the mid-1990s on the migration success of these stocks.

Table 5. Pre-season, in-season and post-season estimates of DBEs (differences between estimates) and pMAs (proportional management adjustments). Pre-season and in-season adopted values reflect the final values adopted by the Panel either prior to the season or for in-season management. Observed DBEs are calculated from final in-season estimates of potential spawning escapement and post-season estimates of spawning populations based on field enumeration programs conducted by DFO. (See Appendix A: Glossary of terms and abbreviations for DBE definition; and footnotes and Appendix G for more details on the methodologies and data sets used for each aggregate).

Description	Early Stuart [1]		Early Summer Aggregate [2]		Summer Aggregate [3,5]		Late Aggregate [4,5]	
	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA
Pre-season adopted[4]	NA	NA	-28%	0.39	-6%	0.06	-48%	0.92
In-season adopted[5]	NA	NA	-28%	0.39	NA	NA	NA	NA
Observed[6]	-64%	1.78	-57%	1.34	-18%	0.23	-63%	1.67

1 Given the pre-season forecast of abundances, fisheries decisions that could impact the Early Stuart sockeye management group were based on a Low Abundance Exploitation Rate (LAER) limit. Thus no MAs were adopted pre-season or in-season.

2 The Early Summer aggregate %DBE was estimated from the weighted average of the %DBE for the non-Pitt and non Chilliwack Early Summer component (that is updated in-season based on river conditions) and the %DBE for Pitt of -15% and the %DBE for Chilliwack of -43% (that remain fixed in-season) based on the p50 level of abundances. The combination of in-season run-size estimates and the pre-season adopted management adjustment resulted in the application of a LAER for this group.

3 The Summer aggregate %DBE was estimated from the weighted average of the %DBE for the non-Harrison Summer component (that is updated in-season based on river conditions) and the %DBE for Harrison of -29% (that remains fixed in-season) based on the p50 level of abundances.

4 The Late aggregate preseason %DBE was estimated from the weighted average of the %DBE for the non-Birkenhead Late component (Odd Years (2013 & 2015) historical median) and the %DBE for Birkenhead of -25%, based on the p50 level of abundances.

5 Given the 2017 in-season adopted run sizes, fisheries decisions that could impact Summer and Late run sockeye management groups were based on a Low Abundance Exploitation Rate (LAER) limit.

6 Derived from Near Final escapement estimates

Pre-season MA predictions and 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 and in-river migration timing. 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 (i.e. carcasses, fish holding, fish straying). In contrast, post-season values are calculated independently of any environmental data using post-season estimates of potential spawning and spawning ground escapements.

No management adjustments are applied to Fraser River pink salmon.

Spring snowpack values were above average for most of the Fraser watershed. Forecasts suggested average flow conditions, which could have some buffering effect on the long-range forecast for above average summer air temperatures. However, with higher than average air temperatures and minimal precipitation, discharge dropped to levels similar to, or less than one standard deviation below average for the time of year for most of August and into September. During this period, water temperatures were above average for the time of year and this temperature pattern continued through mid-September. Observed temperatures exceeded the upper range of the optimum temperature for aerobic swimming for Late-run sockeye during most of their 31-day migration period centered on the 50% Hells Gate date[13] (Figure 6).

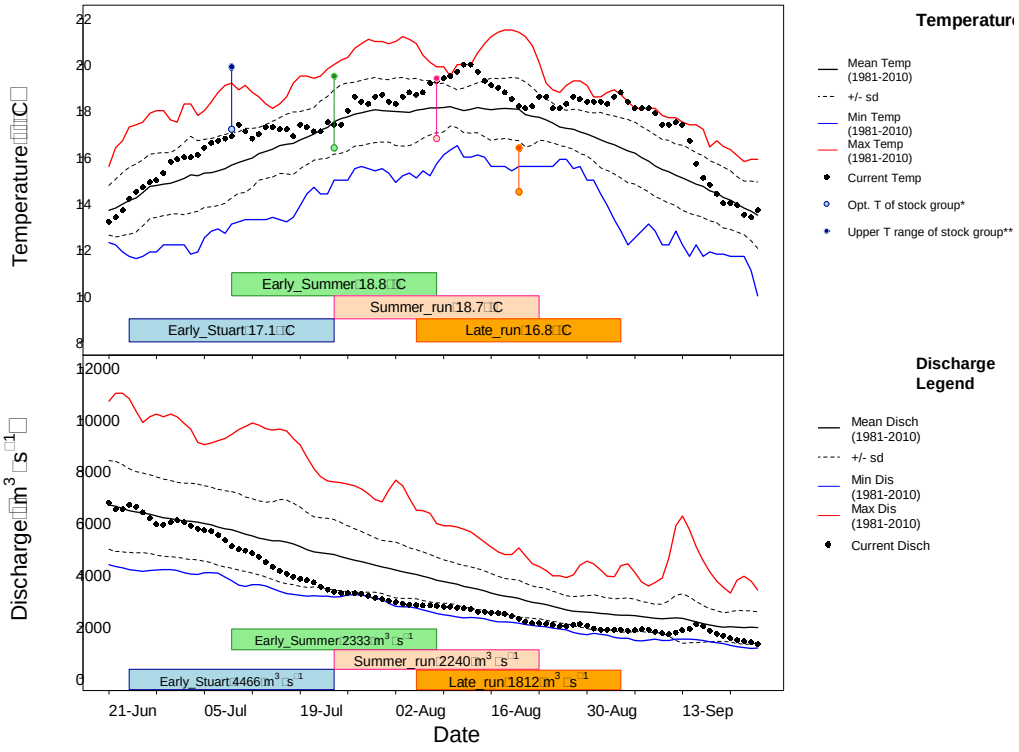

Figure 6. Fraser River temperature and discharge measured near Hope in 2017. Also shown are run timing bars that represent a 31 day spread of the run centred around the Hells Gate date and the mean temperature and discharge for the 31 day spread.

A summary of the pre-season MA models adopted and in-season MA models used during 2017 are provided in the "Management Adjustment and DBE" section in Appendix G. Comparisons of % DBE (pMA) estimates for the pre-season, in-season and post-season periods are shown in Table 5. Given the 2017 pre-season forecast of abundances, fisheries decisions that could impact Early Stuart sockeye were based on a Low Abundance Exploitation Rate (LAER) limit of 10%. The Panel did not adopt a MA for Early Stuart sockeye because it would have no management implications. In-season, reductions to run size estimates resulted in the Summer-run and Late-run groups being managed under a LAER as well. The run size adopted in-season for Early Summer run was slightly higher than its spawning escapement target (SET) and the addition

[13] Elliason, 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 332:109-112.

of the pre-season MA resulted in it being managed under a LAER. Thus MAs were not a relevant factor in determining management actions for three out of the four run timing groups. Predictions from in-season environmental MA models of estimates of %DBEs (Table G3) were presented to the Panel for the Early Summer and Summer run. In-season, environmental conditions were more severe than predicted pre-season and the in-season models predicted larger (more negative) %DBEs for these run timing groups. For Late run, a %DBE prediction from the run-timing MA model using the 50% date at Mission was presented to the Panel. This prediction was also larger than that adopted pre-season.

The observed %DBEs for all run timing groups were higher than those predicted pre-season (see Table 5 for final observed %DBEs). For Early Stuart sockeye, the in-season MA models underestimated (less negative) the observed %DBE. The small Early Stuart return and the sizeable DBE resulted in a much lower spawning escapement (15,400 sockeye) than the spawning escapement target of 47,000 sockeye. For Early Summer-run sockeye, the in-season MA models successfully predicted the observed %DBE for the Early Summer run excluding Pitt and Chilliwack group. However, weighting the larger (more negative) predictions for the Early Summer run excluding Pitt and Chilliwack with the fixed %DBE values for Pitt and Chilliwack reduced (more positive) the predicted in-season %DBE for the Early Summer run aggregate. The spawning escapement target for Early Summer run (137,000 sockeye) was not achieved. For Summer-run sockeye, the in-season MA models overestimated the observed %DBE(-18%) which was more negative than the %DBE (-6%) adopted pre-season. The small return of Summer-run sockeye and the sizeable DBE resulted in a much lower spawning escapement (784,000 sockeye) than the target of 1,044,000 sockeye. At the end of season the upstream timing model successfully predicted the observed %DBE of (-68%) for the Late run excluding Birkenhead group. This estimate weighted with the fixed %DBE for Birkenhead resulted in a predicted %DBE for the Late run aggregate that was very similar to the observed %DBE (-63%). The small Late run return and sizeable DBE resulted in a much lower spawning escapement (75,500 sockeye) than the target of 231,000 sockeye.

In recent years, pre-season MA estimates for some management groups have been estimated based on the weighted average of component abundances and their respective %DBEs (see Table G4). In such cases, changes in relative abundances of component stocks may impact the MAs for the aggregate. This weighting procedure had a significant impact on moderating the high %DBE predicted by the model for Early Summer run in 2017.

D. Mission Passage

Mission passage estimates for sockeye and pink salmon decreased slightly post-season (by 2%) to reflect a small correction to the estimates from the mobile system that could not be verified until post-season. Upstream passage through the Fraser River at Mission totalled 1,421,500 sockeye, consisting of 45,700 Early Stuart, 155,000 Early Summer-run (including Pitt), 1,017,300 Summer-run, and 203,500 Late-run sockeye (Table 6). The total passage of pink salmon at Mission was 3,410,000. Sockeye and pink salmon passage estimates were derived from either hydroacoustics monitoring at Mission or expansion of CPUE data from the Whonnock gillnet test fishery. Sockeye passage estimates were derived from hydroacoustics during the peak sockeye migration period from July 7 to August 24, while CPUE-derived estimates from Whonnock were used to determine sockeye passage from June 30 to July 6 and August 25 to September 25. Pink salmon passage was estimated using hydroacoustics throughout the entire migration period except from September 26 to September 30 when a CPUE-derived estimate was used following the termination of the Mission hydroacoustics program.

Salmon passage was estimated by the Mission hydroacoustics program using the same standardized sampling method as in recent years by combining observations from a vessel-based split-beam, a shore-based split-beam on the left bank, and a shore-based DIDSON (Dual Frequency Identification Sonar) on the right bank. However, unlike recent pink return years, the

left bank imaging sonar was not adopted for the official estimate of salmon passage during the peak pink migration because there was no evidence of saturation of the split-beam. Detailed descriptions of the hydroacoustics estimation methodology for 2017 are provided in Appendix G.

Table 6. Fraser River sockeye and pink salmon passage at Mission in 2017.

Management Group	Mission Escapement	
Stock Group	fish	%
Early Stuart	**45,700**	**3%**
Early Summer	**155,000**	**11%**
Chilliwack	16,100	1%
Early Miscellaneous	33,200	2%
Early South Thompson	15,800	1%
North Barriere/Taseko	4,000	0%
Pitt[1]	85,900	6%
Summer	**1,017,300**	**72%**
Raft/N.Thompson	54,000	4%
Chilko	502,300	35%
Quesnel	148,000	10%
Late Stuart/Stellako	245,500	17%
Harrison	67,600	5%
Late	**203,500**	**14%**
Birkenhead	44,900	3%
Late Shuswap/Portage	54,800	4%
Weaver/Cultus	103,800	7%
Total Sockeye	**1,421,500**	**100%**
Pink Salmon	**3,410,000**	**100%**

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

V. RUN SIZE, CATCH AND ESCAPEMENT

A. Sockeye Salmon

The total abundance of sockeye salmon in 2017 was 1,471,200 fish (Tables 7 and 8), which is 67% smaller than the median forecast of 4,431,500 fish and about one third the total adult return in 2013 (4,279,000). The 2017 return was the second smallest estimated run size on this cycle and the fourth smallest run-size overall all years since estimates began in 1893 (Figure 7). The causes of the small 2017 Fraser River sockeye return are unknown. Four year old Chilko sockeye were expected to contribute nearly two thirds of the median pre-season forecast for the Summer-run group. In-season, the return of age four Chilko fish was much lower than its median forecast. This apparent poorer than expected survival of Chilko four-year-olds, coupled with the poor returns relative to forecast of several other Fraser sockeye stock groups (see below), suggests that a marine mechanism may have caused the poor productivity observed in 2017. However, returns of other sockeye stocks and other salmon species which shared at least part of their ocean residence with Fraser River sockeye were not uniformly poor. Thus, while it is tempting to blame the low return on the anomalously warm ocean temperatures in the Gulf of Alaska where age 4 Fraser River sockeye that returned in 2017 reared from late fall of 2015 through the spring of 2017, the

lack of consistent response among populations and species, suggests a more complicated causal mechanism.

Table 7. Catch, escapement, difference between estimates and run size for Fraser River sockeye (by management group) and pink salmon in 2017.

	Fraser Sockeye						Fraser Pinks	
	Early Stuart	Early Summer	Summer	Late	Total	% of Run	Total	% of Run
CANADIAN CATCH	**2,600**	**1,900**	**62,700**	**4,600**	**71,900**	**5%**	**37,200**	**1%**
Commercial Catch	**0**	**0**	**0**	**0**	**0**	0%	**0**	**0%**
Panel Area	0	0	0	0	0	0%	0	0%
Non-Panel Areas	0	0	0	0	0	0%	0	0%
First Nations Catch	**2,600**	**1,900**	**62,600**	**4,600**	**71,700**	5%	**33,600**	**1%**
Marine FSC	50	500	6,100	2,800	9,400	1%	14,800	0%
Fraser River FSC	2,600	1,400	56,500	1,800	62,300	4%	18,900	1%
Economic Opportunity	0	0	0	0	0	0%	0	0%
Non-commercial Catch	**0**	**10**	**100**	**40**	**100**	0%	**3,500**	**0%**
Marine Recreational	0	0	0	0	0	0%	0	0%
Fraser Recreational	0	0	0	0	0	0%	0	0%
Charter (Albion & Area 12 Chum)	0	10	100	40	100	0%	3,500	0%
ESSR	0	0	0	0	0	0%	0	0%
UNITED STATES CATCH	**0**	**30**	**900**	**600**	**1,500**	**0%**	**102,200**	**3%**
Washington Total	**0**	**30**	**900**	**600**	**1,500**	**0%**	**102,200**	**3%**
Commercial catch	**0**	**0**	**0**	**0**	**0**	0%	**102,200**	**3%**
Treaty Indian	0	0	0	0	0	0%	91,300	3%
All Citizen	0	0	0	0	0	0%	10,900	0%
Non-commercial Catch	**0**	**30**	**900**	**600**	**1,500**	0%	**30**	**0%**
Ceremonial	0	30	900	600	1,500	0%	30	0%
Recreational	0	0	0	0	0	0%	0	0%
Alaska* **					NA		0	0%
TEST FISHING CATCH	**300**	**1,400**	**10,200**	**1,900**	**13,800**	**1%**	**17,700**	**0%**
PSC (Panel Areas)	**300**	**900**	**5,300**	**800**	**7,400**	**1%**	**13,700**	**0%**
Canada	300	900	5,300	800	7,400	1%	11,800	0%
United States	0	0	0	0	0	0%	1,800	0%
Canada (non-Panel Areas)	**10**	**500**	**4,800**	**1,100**	**6,500**	**0%**	**4,000**	**0%**
TOTAL RUN	**45,900**	**160,100**	**1,048,400**	**216,800**	**1,471,200**	**100%**	**3,549,200**	**100%**
Total Catch in All Fisheries	3,000	3,400	73,700	7,200	87,200	6%	157,100	4%
Adult Spawning Escapement *	15,400	65,600	783,700	75,500	940,100	64%	3,392,200	96%
Jack Spawning Escapement	10	2,900	5,100	7,800	15,800	1%	0	0%
Difference Between Estimates**	27,500	88,300	185,900	126,400	428,100	29%	0	0%
Percentage of Total Run	**100%**	**100%**	**100%**	**100%**	**100%**		**100%**	
Total Catch in All Fisheries	6%	2%	7%	3%	6%		4%	
Spawning Escapement	34%	43%	75%	38%	65%		96%	
Difference Between Estimates	60%	55%	18%	58%	29%		0%	

* Spawning escapement estimate for Cultus sockeye include 111 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 componenets of management groups. This only impacted the small DBE (8,590) for the Late Stuart/Stellako group in 2017.

*** The preliminary Alaska catch of Fraser sockeye in D104 is estimated to be 18,700

All management groups returned at lower abundances than their median (50p level) pre-season forecast abundances. The total return of Early Stuart sockeye was 45,900 adults (Table 8) less than half the median forecast level of 99,000 fish. Early Summer-run sockeye returns totalled 157,200 fish, slightly less than half of the median forecast level. The dominant Early Summer-run

component was Pitt sockeye (86,800). The abundance of Summer-run sockeye was 1,043,300 adults, only 32% of the median forecast level. Most Summer-run fish were from the Chilko group which had poorer than expected survival. The total abundance of the Harrison group (68,800 adults) was about one third of its median pre-season forecast of 251,000 fish. Returns to all Late-run components were very poor relative to their median forecasts resulting in an aggregate Late-run return (209,000 adults) that was only 64% of the group's median pre-season forecast.

Table 8. Catch, escapement, difference between estimates, run size and exploitation rate for Fraser River sockeye (by stock group) and pink salmon in 2017.

Management Group / Stock Group	Catch	Adult Spawning Escapement	Difference Between Estimates[3]	Abundance			Portion of Run	Adult Exploitation Rate
				Adult	Jack [1]	Total		
Fraser Sockeye Salmon								
Early Stuart	**3,000**	**15,400**	**27,500**	**45,900**	**10**	**45,900**	**3%**	**7%**
Early Summer-run	**3,400**	**65,600**	**88,300**	**157,200**	**2,900**	**160,100**	**11%**	**2%**
Chilliwack	100	6,700	9,300	16,200	0	16,200	1%	1%
Early Miscellaneous	1,600	14,100	18,500	34,200	400	34,600	2%	5%
Early South Thompson	700	9,900	5,500	16,100	2,400	18,500	1%	4%
North Barriere/Taseko	100	700	3,200	4,000	10	4,000	0%	3%
Pitt	800	34,200	51,800	86,800	0	86,800	6%	1%
Summer-run	**73,700**	**783,700**	**185,900**	**1,043,300**	**5,100**	**1,048,400**	**71%**	**7%**
Raft/N.Thompson	1,900	11,700	41,000	54,600	0	54,600	4%	3%
Chilko	41,800	369,700	98,800	510,300	2,600	513,000	35%	8%
Quesnel	7,400	114,200	28,800	150,400	1,600	152,000	10%	5%
Late Stuart/Stellako	21,200	238,000	0	259,200	900	260,100	18%	8%
Harrison/Widgeon	1,400	50,100	17,300	68,800	0	68,800	5%	2%
Late-run	**7,200**	**75,500**	**126,400**	**209,000**	**7,800**	**216,800**	**15%**	**3%**
Birkenhead/BigSilver	700	25,600	19,100	45,400	10	45,400	3%	2%
Late Shuswap/Portage	3,100	16,300	37,400	56,700	7,600	64,400	4%	5%
Weaver/Cultus	3,400	33,600 *2*	69,900	106,900	100	107,000	7%	3%
Total	**87,200**	**940,100**	**428,100**	**1,455,400**	**15,800**	**1,471,200**	**100%**	**6%**
Portion of Total Run	6%	64%	29%	99%	1%	100%		
Fraser Pink Salmon								
Total	**157,100**	**3,392,200**	**0**	**3,549,200**	**0**	**3,549,200**	**100%**	**4%**
Portion of Total Run	4%	96%	-	100%		100%		

1 ESSR catches are included in the total Weaver and pink salmon total.

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 111 individuals captured as brood stock.

3 Difference between estimates as at the time of the final spawning ground estimates. Also, consistent with Panel advice, positive DBEs were set to zero for all componenets of management groups. This only impacted the small DBE (8,590) for the Late Stuart/Stellako group in 2017.

The total sockeye catch of 87,200 fish was about 6% of the run (Tables 7 and 8). This exploitation rate is the lowest in recent years (Figure 8). Of the total sockeye catch, 71,900 fish were caught in Canada, and 1,500 fish in the U.S. and 13,800 fish in test fisheries (Table 7). Virtually all of the Canadian catch was taken in First Nations Food, Social and Ceremonial (FSC) fisheries directed on other salmon species. There was no recreational or commercial catch in Canada. In Washington State there was no commercial catch taken but a catch of 1,500 sockeye was taken in Treaty Indian Ceremonial and Subsistence fisheries directed at Fraser River pink salmon (Table 9). The Alaska catch of Fraser sockeye was estimated to be 18,700.

DFO annually assesses the spawning ground abundance of sockeye populations in the Fraser watershed (Figure 9). In 2017, the near-final estimate of adult spawners (primarily age 4 and age 5 fish) totalled 940,100 fish, or 64% of the total run. This escapement was less than half of the brood year (2013) escapement of 2,479,500 adults.

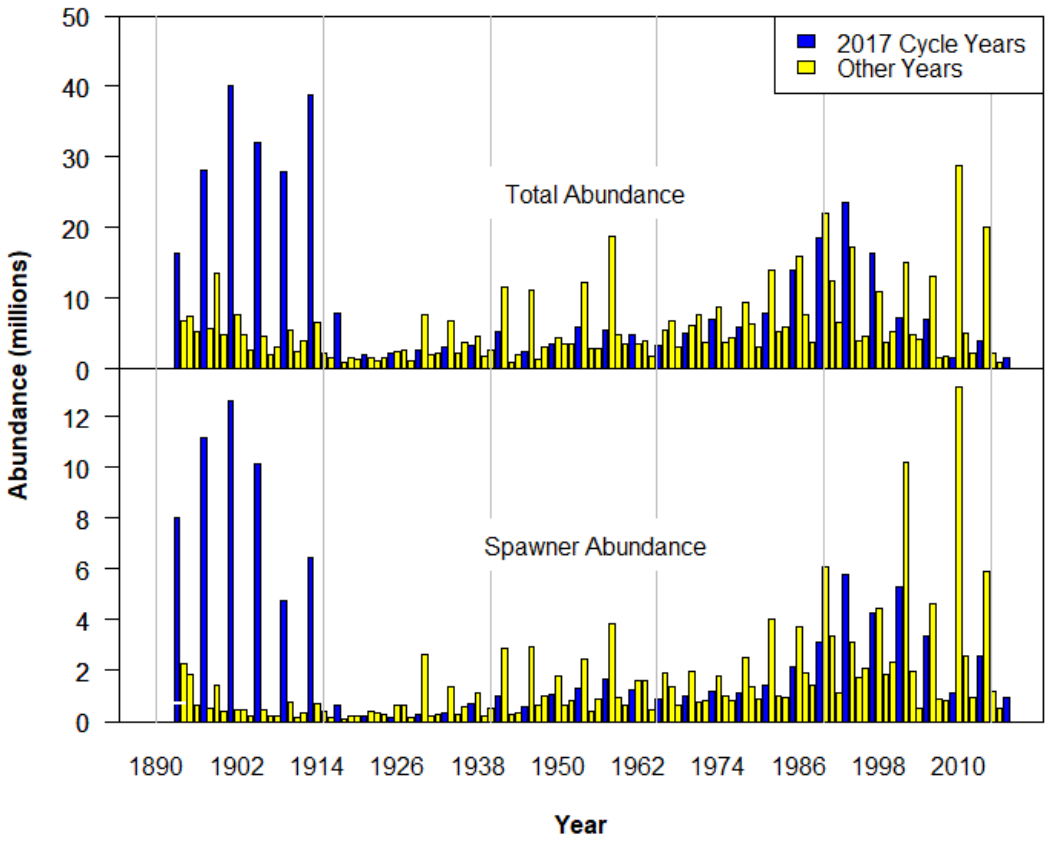

Figure 7. Total run size and spawning escapement of Fraser River sockeye salmon in 1893-2017. Returns on the 2017 cycle are emphasized.

Spawner abundances for most management groups were much less than those observed in the brood year (2013, Figure 10). By management group and for this cycle line, spawning escapements in 2017 were the second lowest escapement on record for the Early Stuart system, well below historical average for the Early Summer and Summer-run with the exception of Chilko and Stellako stocks, and the lowest cycle year escapement on record for the Late run. The very low escapements relative to those in the brood year are attributed primarily to the combination of low overall returns and the very warm Fraser River temperatures that Fraser sockeye experienced during their upstream migrations in 2017 which contributed to the large observed DBEs.

The overall spawning success of adult female sockeye in the Fraser watershed was 96%. The effective female spawning population in 2017 totalled 515,700 fish, which was less than half the number of effective females in 2013.

The DBE[14] estimate was 428,100 fish, or 29% of the total return. As a percentage of run size for each management group, Early Stuart, Early Summer and Late run had the largest DBE's ranging from 55- 60% and the Summer run had a DBE of 18% (Tables 7 and 8).

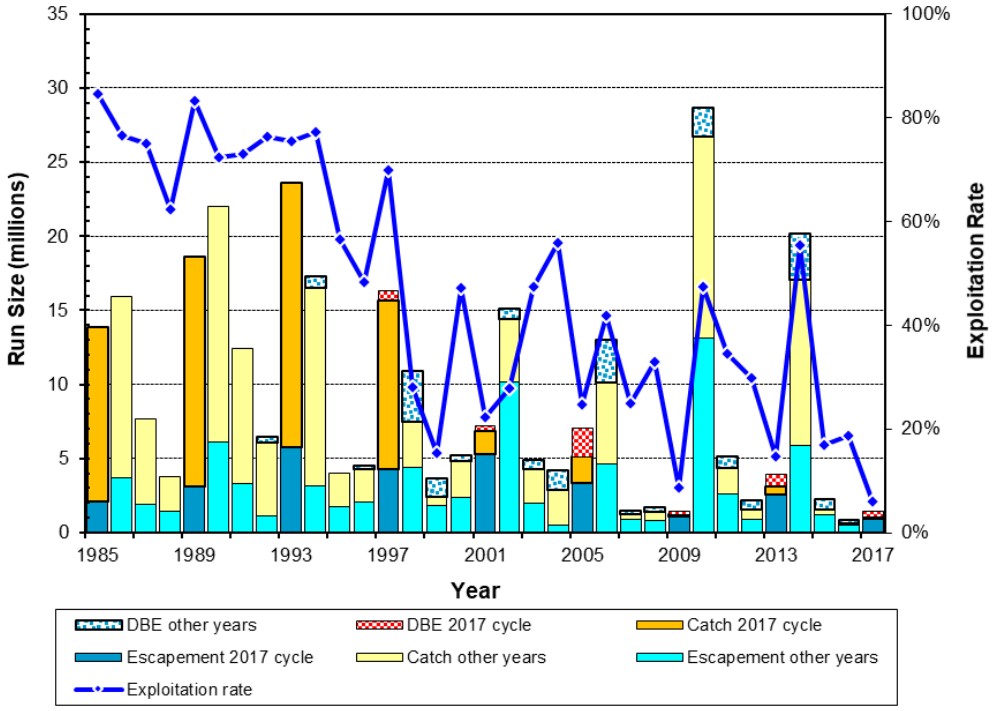

Figure 8. Total catch, escapement, difference between estimates, run size and exploitation rate for Fraser River sockeye salmon in 1985-2017, with returns on the 2017 cycle emphasized.

Further details regarding sockeye salmon abundances, catches and spawning escapements including comparisons with the previous four cycle years can be found in Appendix H (Tables H1 and H3).

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

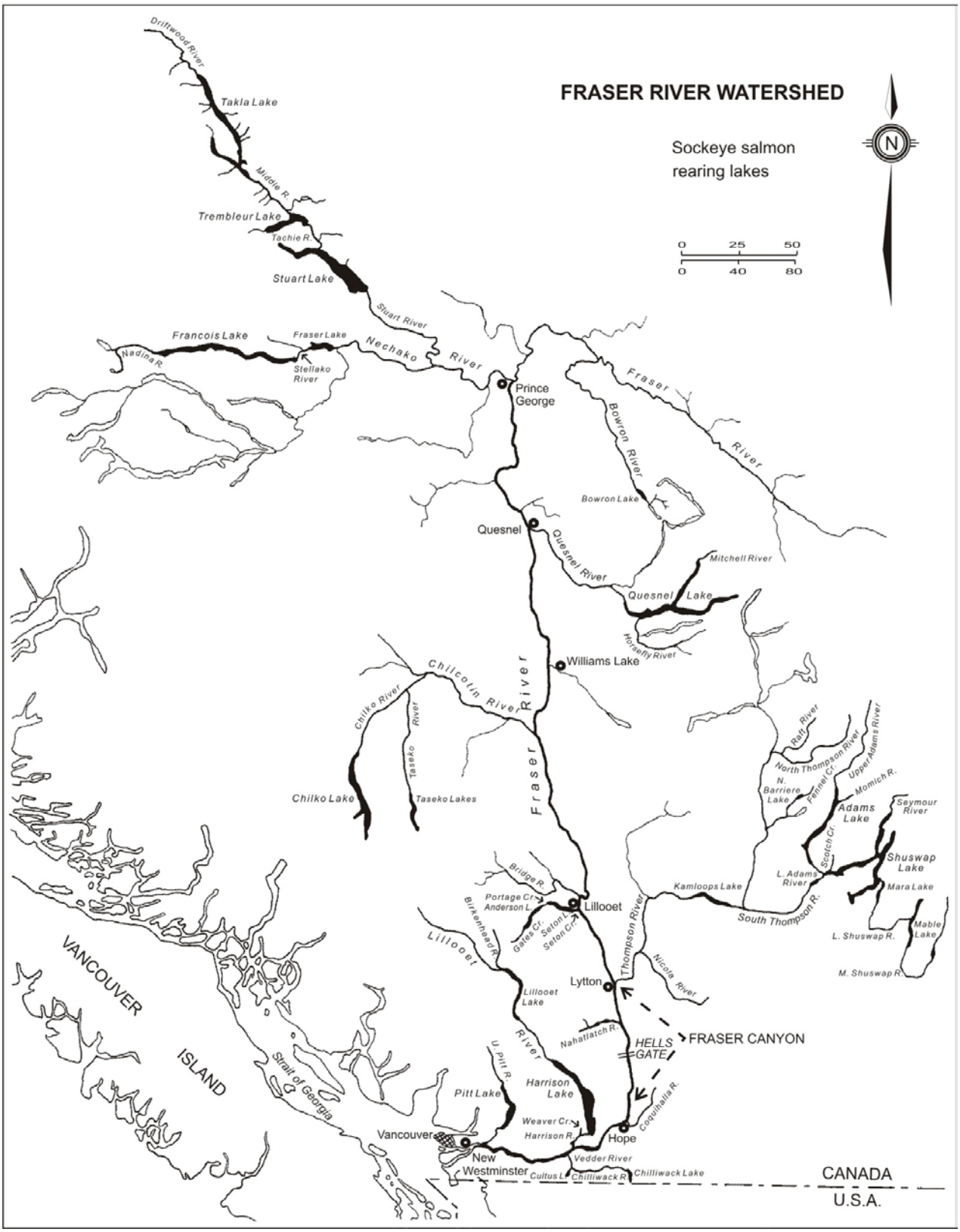

Figure 9. Sockeye salmon spawning areas in the Fraser River watershed.

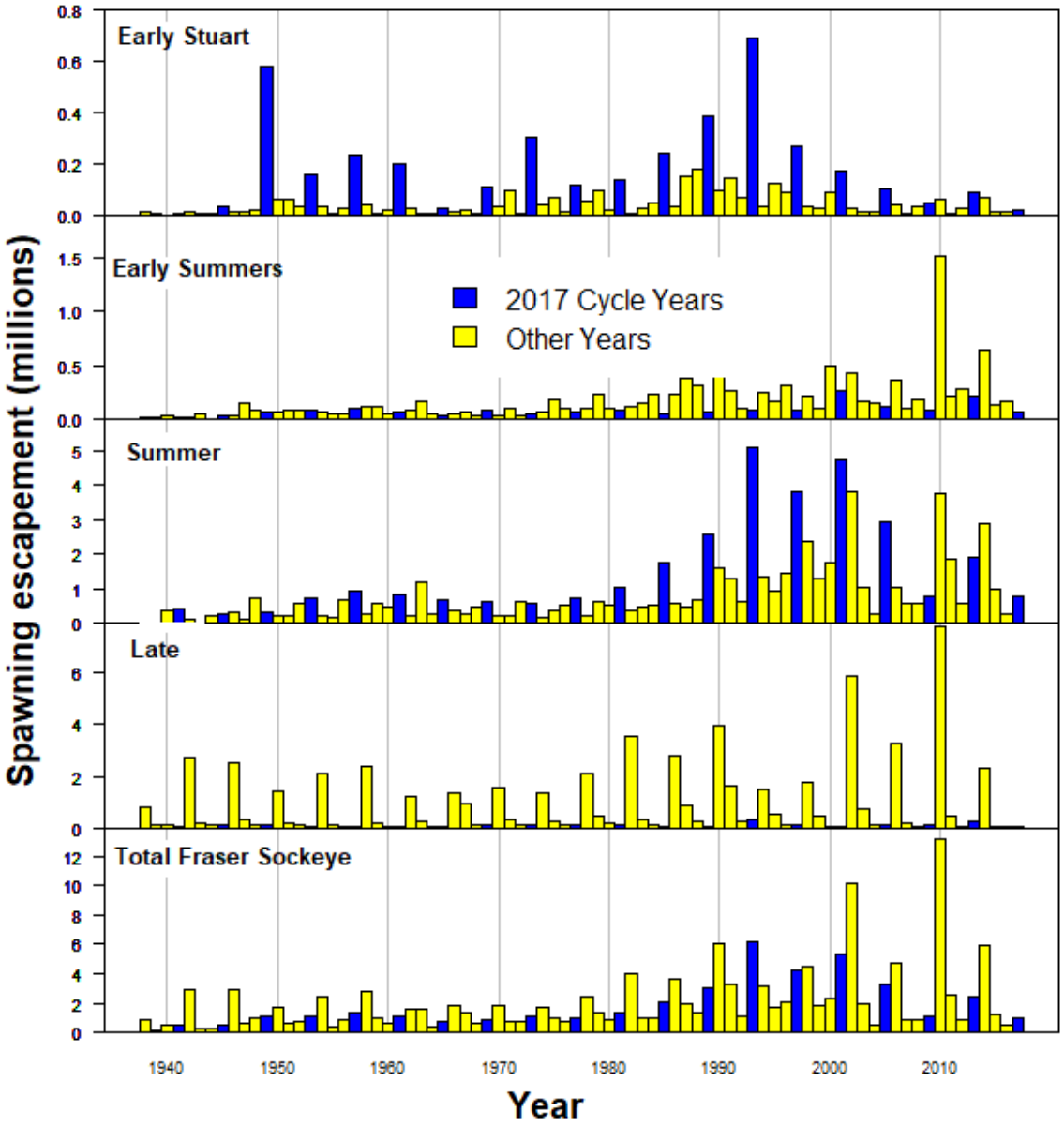

Figure 10. Annual adult spawning escapement of Fraser River sockeye salmon for each management group and for total sockeye in 1938-2017, with escapements on the 2017 cycle emphasized.

A. Pink Salmon

The in-season run-size estimate of 3,549,200 fish is less than half of the median pre-season forecast of 8,693,000 fish (Table 1). Hydroacoustic research has provided Staff with the ability to reliably estimate pink salmon passage at Mission. Summing this passage estimate (3,410,000) with the catch below Mission (138,900) provided the in-season estimate of total abundance noted above.

The 2017 return was substantially lower than average and the smallest Fraser River pink salmon run size since 1965 (Figure 11). Returns of Fraser pink salmon (Figure11) have shown large variation in recent years, with 2017 being the lowest return since 1965, and 2003 being the largest return (26,000,000 fish) since records began in 1959.

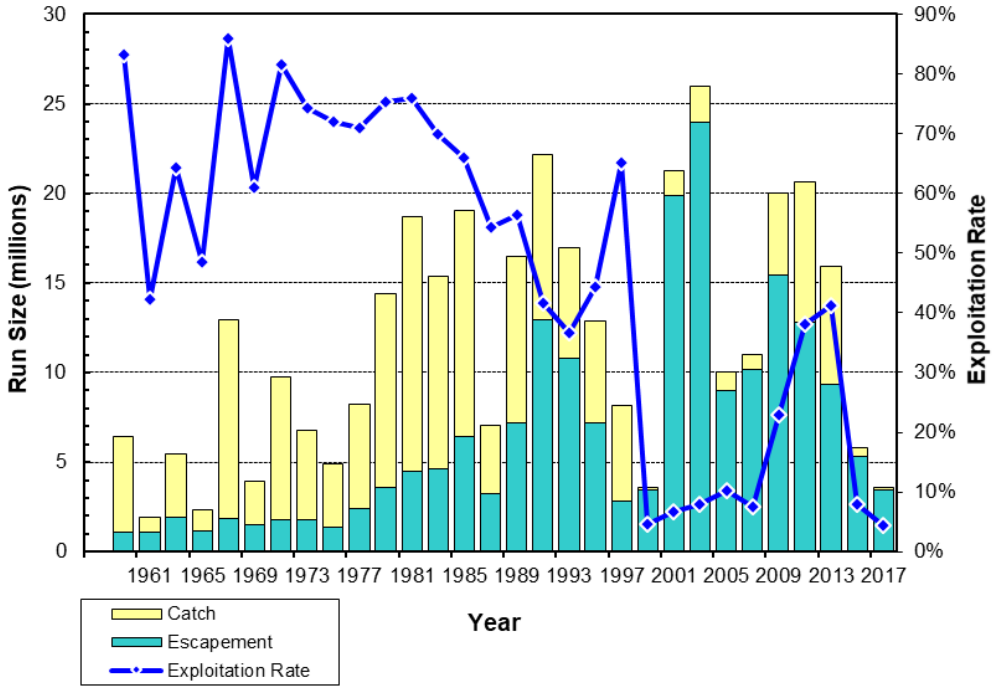

Figure 11. Total catch, escapement, run size and exploitation rate for Fraser River pink salmon in 1959-2017.

The exploitation rate of Fraser River pink salmon in 2017 was 4%, similar to the low exploitation rates (5-10%) observed in 1999-2007, and 2015, and much smaller than the 1959-1989 average exploitation rate of 68% (Figure 11). The low exploitation rates observed in the 1999-2007 period were a result of poor markets for the sale of pink salmon and conservation concerns for Late-run sockeye that co-migrate with pink salmon. These low harvest levels have resulted in substantial spawning escapements of Fraser pinks in recent years. In 2017, Late-run conservation concerns coupled with the much lower than expected return of pink salmon were the primary factors constraining pink-directed fisheries in both countries. Limited pink-directed fisheries were possible in US waters due to the low sockeye encounter rates along the Juan de Fuca migration route. Despite limited harvests, the low overall Fraser pink salmon return also resulted in a small pink salmon escapement. Overall, the pink salmon return in 2017 had the smallest catch since 1959 and one of the smallest spawning escapements since 1999.

Of the total Fraser River pink salmon catch, 37,200 were caught in Canada, 102,200 in the U.S. and 17,700 in test fisheries (Table 7). There was no Canadian commercial catch but there was a First Nations catch of 33,600 and a Charter catch of 3,500. The U.S. catch included a commercial catch of 102,000, of which 91,000 were caught in Treaty Indian fisheries and the remainder were caught in All Citizen fisheries (Table 9).

Further details on Fraser River pink salmon abundances, catches and spawning escapements including historical production data can be found in Appendix H (Tables H2 and H4).

Table 9. U.S. commercial catches of Fraser River pink salmon by user group, gear type and statistical area in 2017.

Areas	Purse Seine	Gillnet	Reefnet	Total
Panel Area (Washington)	**95,000**	**0**	**7,000**	**102,000**
Treaty Indian *	**91,000**	**0**	**0**	**91,000**
4B, 5 and 6C	0	0	0	0
6 and 7	15,000	0	0	15,000
7A	76,000	0	0	76,000
Non-Indian **	**4,000**	**0**	**7,000**	**11,000**
7	0	0	7,000	7,000
7A	4,000	0	0	4,000
Non-Panel Area				**0**
United States Total				**102,000**

* 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. Spawning escapement targets were determined by applying Canada's spawning escapement plan to abundance estimates for each management group or to the total return in the case of Fraser River pink salmon.

In-season monitoring of the progress toward spawning escapement targets is not directly measureable 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 targets for potential spawning escapement (i.e., PSE target = in-season spawning escapement target + MA). Progress towards these targets is monitored by comparison with in-season PSE estimates (i.e., Mission escapement to-date - catch above Mission).

Final in-season PSE estimates indicate under achievement of in-season PSE targets among all management groups: Early Stuart (9% under), Early Summer (7% under), Summer (8% under) and Late (13% under) (Table 10). As discussed in the pre-season planning section, for pre-season planning purposes, Early Stuart sockeye were constrained by a 10% Low Abundance Exploitation

Rate (LAER). For the Early Summer run, the combination of the lower than forecasted abundance and the adopted %DBE also triggered a LAER. Due to low run sizes, the Summer and Late run were also managed under a LAER (10% and 20%, respectively). As the season progressed the sockeye TAC and available harvest decreased dramatically (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 2017.

	Final	Potential Spawning Escapement (PSE)					
Management Group	In-season Abundance Estimate	Spawning Escapement Target	Management Adjustment *	In-season PSE ** Target	PSE *** Estimate	Difference Fish	Difference %
Adult sockeye	**1,487,000**	**1,459,000**	**328,500**	**1,487,000**	**1,359,000**	**-127,000**	**-9%**
Early Stuart	47,000	47,000	NA	47,000	43,000	-4,000	-9%
Early Summer	165,000	137,000	53,400	165,000	154,000	-11,000	-7%
Summer	1,044,000	1,044,000	62,600	1,044,000	961,000	-83,000	-8%
Late	231,000	231,000	212,500	231,000	202,000	-29,000	-13%

* 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.

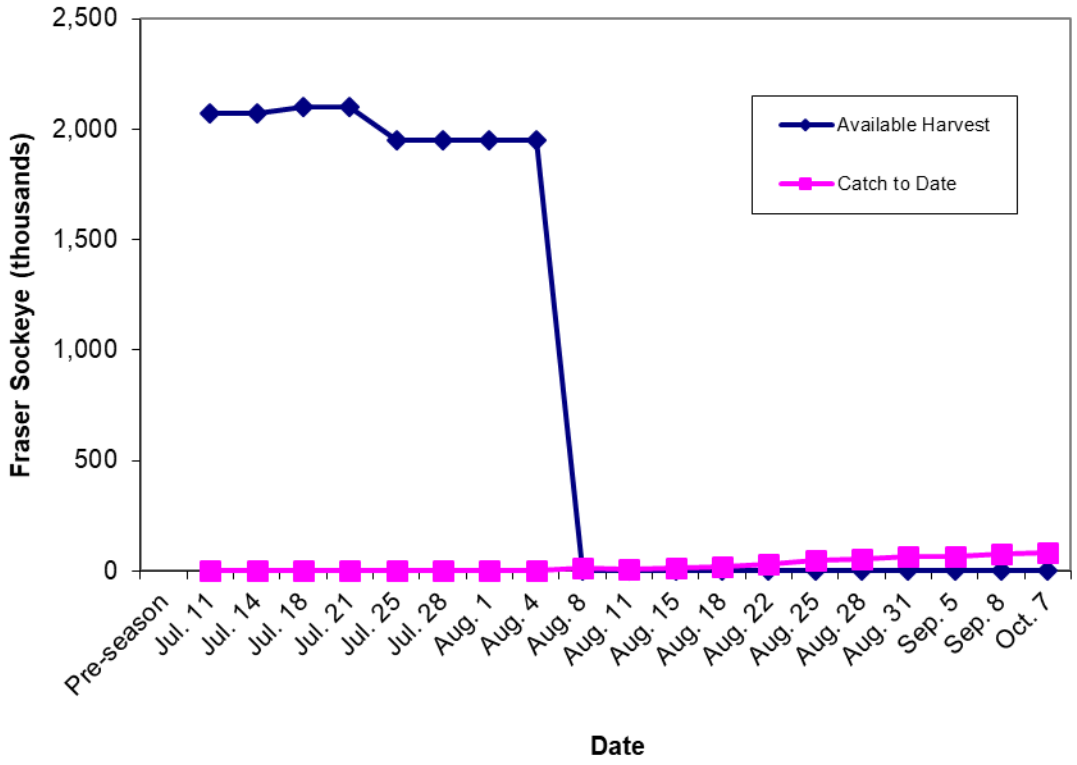

Figure 12. Available harvest of Fraser sockeye compared to catch to date in all fisheries in 2017. The available harvest is calculated as run size minus spawning escapement target and management adjustment, and represents fish that are available for catch in all commercial, recreational, First Nations and test fisheries.

In terms of the achievement of post-season objectives, the total spawning ground escapement estimate of Fraser sockeye was 35% below the target, while the estimated escapement of Fraser River pink salmon was 3% larger than its target (Table 11). Spawning ground escapement estimates for each sockeye management group were 25-66% below their targets (Table 11). The spawning escapement targets for Early Stuart, Summer and Late-run sockeye equalled their run sizes, so the escapement targets were unattainable unless there was no harvest and no difference between estimates. The exploitation rate for Early Summer run (2%) was low and less than the LAER (10%). Thus, the negative deviations observed between spawning escapements and targets largely reflect the impact of the negative %DBEs observed for this group (Table 5). Initially, the Early Summer and Summer-run return were sufficient to generate a TAC, but in-season reductions in run size and harvest restrictions on co-migrating Early Stuart and Late-run groups limited directed fisheries. After July 21 the Early Summer run management group was in a LAER and by August 11 the Summer-run management group was also in a LAER. Despite the fact that harvest opportunities were restricted by LAERs, none of the four management groups were able to meet the spawning escapement targets (Table 11) largely because of the negative %DBEs observed for each group (Table 5).

Table 11. Comparison of post-season spawning escapement targets and escapement estimates for adult Fraser River sockeye and pink salmon in 2017. Post-season estimates of sockeye escapement are from spawning ground enumeration programs (DFO), while pink salmon escapement was estimated by subtracting total catch from the run-size estimate.

Management Group	Post-season Run-size Estimate	Spawning Escapement			
		Post-season Target	Adult Estimate	Difference	
				Fish	%
Sockeye salmon	**1,471,200**	**1,448,100**	**940,100**	**-507,900**	**-35%**
Early Stuart	45,900	45,900	15,400	-30,500	-66%
Early Summer	160,100	137,000	65,600	-71,400	-52%
Summer	1,048,400	1,048,400	783,700	-264,700	-25%
Late	216,800	216,800	75,500 *	-141,300	-65%
Pink salmon	**3,549,200**	**3,281,500**	**3,392,200**	**110,700**	**3%**

* Late-run escapement estimate includes 111 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 relinquished control of the last U.S. Panel Area (October 7). The test fishing catch and Aboriginal Fisheries Exemption deductions are the post-season estimates, however.

With the total in-season abundance estimate of 1,487,000, minus deductions for spawning escapement, MA, test fishing catch and AFE, there was no International TAC for Fraser River sockeye in 2017 (Table 12). Due to the 900 fish payback and the catch of 1,500 fish in Washington, the United States exceeded it share by 2,400 fish (Table 12). For TAC comparison purposes, Canada's catch excludes ESSR catch. In 2017, the ESSR catch was 0 fish. Canada's catch of 71,900 Fraser sockeye deviated by 800 fish less than the total of their allowable harvest of the International TAC plus the AFE of 72,600. A detailed version of the TAC calculations by management group is presented in Appendix H, Table H5.

The TAC for Fraser pink salmon was 273,200 fish, with a U.S. share of 70,200 fish (25.7%) and Canadian allowable harvest of 203,000 fish (Table 12). The U.S. caught more than their share (32,000 over) and Canada caught less than their share (165,800 under).

Table 12. Total allowable catch (TAC) and achievement of international catch shares for Fraser River sockeye and pink salmon in 2017. TAC calculations use the in-season estimates of run size, spawning escapement target and management adjustment at the time the Panel relinquished control of the last U.S. Panel Area (October 7), in accordance with Annex IV, Chapter 4 of the Treaty.

		Sockeye		Pink	
TOTAL ALLOWABLE CATCH					
In-season Total Run Size		**1,487,000**		**3,700,000**	
Deductions		**1,873,100**		**3,426,800**	
In-season Spawning Escapement Target		1,459,000		3,409,100	
In-season Management Adjustment		328,600		n/a	
Aboriginal Fishery Exemption (AFE)		71,700		n/a	
Post-season Test Fishing Catch		13,800		17,700	
Total Allowable Catch	*1, 2*	**0**		**273,200**	
UNITED STATES					
Washington Total Share	*3*	**-900**		**70,200**	
Washington Share of TAC	*1*	0	16.5%	70,200	25.7%
Payback		-900		0	
Washington Catch		**1,500**		**102,200**	
Deviation		**-2,400**		**-32,000**	
In-season Alaska Catch Estimate		0		0	
CANADA					
Canadian Share of TAC + U.S. Payback + AFE		**72,600**		**203,000**	
Canadian Catch excluding ESSR Catch		**71,900**		**37,200**	
Deviation		**800**		**165,800**	

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

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

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

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 Indian fishers in the U.S. caught more than their share of the sockeye salmon TAC; 1,500 fish (Table 13). Similarly, regarding Fraser pink salmon, Treaty Indian fishers caught more than their share of the pink salmon TAC (56,200 over) while All Citizen fishers caught less than their share of the TAC (24,200 under; Table 14).

The only fisheries in Canada directed on Fraser sockeye and pink salmon were in First Nations FSC fisheries. First Nations fisheries harvested 71,700 sockeye which was their allowable harvest (Tables 7,12). The harvest of 33,600 Fraser pink salmon in First Nations fisheries was less than Canada's share (Tables 7, 12). An additional 100 Fraser River sockeye and 3,500 Fraser River pink salmon were caught in domestic, Chinook and chum test fisheries.

Table 13. Achievement of domestic catch goals in Washington for Fraser River sockeye salmon in 2017.

	Actual Catch		Share of TAC		
User Category	Fish	%	Fish	%	**Deviation**
Washington Total	**1,500**	**100.0%**	**(900)**	**100.0%**	**2,400**
Treaty Indian *	1,500	100.0%	(900)	67.7%	2,400
All Citizen **	0	0.0%	0	32.3%	0

* Treaty Indian catch was exclusively landed for ceremonial and subsistence (C&S) purposes in 2017. Since all the 900 fish payback was also landed by Treaty Indian fishers as C&S, the entire payback is assigned to Treaty Indian fisheries in calculating domestic catch goals.

** All Citizen catch includes commercial and recreational catches.

Table 14. Achievement of domestic catch goals in Washington for Fraser River pink salmon in 2017.

	Actual Catch		Share of TAC		
User Category	Fish	%	Fish	%	**Deviation**
Washington Total	**102,230**	**100.0%**	**70,200**	**100.0%**	**32,000**
Treaty Indian *	91,330	89.3%	35,100	50.0%	56,200
All Citizen **	10,900	10.7%	35,100	50.0%	-24,200

* Treaty Indian 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. There was no by-catch of non-Fraser sockeye and pink salmon in commercial net fisheries regulated by the Fraser River Panel; however, catches of other Fraser and non-Fraser salmon species included 2,520 Chinook, 200 Coho, and 100 chum (Table 15).

Table 15. Catches of non-Fraser sockeye and pink salmon and catches of other salmon species in commercial fisheries regulated by the Fraser River Panel in 2017.

Area and Gear	Non-Fraser		Fraser and Non-Fraser			
	Sockeye	Pink	Chinook	Coho	Chum	Steelhead
United States *	**0**	**0**	**2,520**	**200**	**100**	**0**
Areas 4B, 5 and 6C Net	0	0	0	0	0	0
Areas 6, 7 and 7A Net	0	0	2,520	200	100	0
Canada **	**0**	**0**	**0**	**0**	**0**	**0**
Area 20 Net	0	0	0	0	0	0
Area 29 Net	0	0	0	0	0	0
Total	**0**	**0**	**2,520**	**200**	**100**	**0**

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

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

** There were no commercial fisheries directed at Fraser River sockeye or pink salmon in Canadian Panel waters in 2017.

VII. ALLOCATION STATUS

Annex IV, Chapter 4, (paragragh 8 (c)(iv)) specifies that *the US share will not be adjusted for an overage resulting from TAC reductions after the scheduling of the last Fraser River Panel approved U.S. fishery of the season.* The resulting calculations indicate there was an overage for Fraser River sockeye in 2017 (Table 16). The Panel agreed post-season that the 900 sockeye landed in Panel regulated fisheries directed at Fraser River pink salmon in 2015 would be carried over as payback to 2018, as well as the 1,500 sockeye caught in the 2017 season. Thus, the U.S. owes a total payback of 2,400 Fraser sockeye to Canada in future years (Table 16). These sockeye were not sold, but retained by US tribes for ceremonial and subsistence purposes. The resulting calculations also indicate there was no paybacks due for Fraser River pink in 2017 (Table 16) based on the scheduling of the last US pink fishery on August 31.

Table 16. Allocation status for Fraser River sockeye and pink salmon in 2013-2017. After 2017, the US owed a payback of 2,400 sockeye salmon.

	2013 (Oct 05)	2014 (Oct 04)	2015 (Aug 07)	2016 (Aug 02)	2017 (Oct 7)
TOTAL ALLOWABLE CATCH					
Total Run Size	3,732,000	19,883,500	6,367,000	2,110,000	1,487,000
Escapement and other deductions	3,649,400	8,688,600	3,758,100	1,542,700	1,487,000
Total Allowable Catch:	82,600	11,194,900	2,608,900	567,300	0
UNITED STATES					
Washington Catch	20,200	701,600	46,200	1,700	1,500
Washington Share (exclds payback) *	13,600	1,847,100	430,500	93,600	0
Deviation:	6,600	-1,145,500	-384,300	-91,900	1,500
Cumulative Allocation Status:	**6,600**	**0**	**900****	**900****	**2400****
CANADA					
Catch	410,100	10,122,800	187,900	149,200	71,900
Share + Aboriginal Exemption	469,000	9,747,800	2,365,600	622,100	71,700
Deviation:	-58,900	375,000	-2,177,700	-472,900	200

TOTAL ALLOWABLE CATCH	2013 (Oct 05)	2015 (Aug 31)	2017 (Aug 31)
Total Run Size	26,000,000	14,455,000	4,800,000
Escapement and other deductions	7,883,400	6,210,900	4,388,100
Total Allowable Catch:	18,116,600	8,244,100	411,900
UNITED STATES			
Washington Catch	3,200,400	330,900	102,200
Washington Share *	4,656,000	2,118,700	105,900
Deviation:	-1,455,600	-1,787,800	-3,700
Cumulative Allocation Status:	**0**	**0**	**0**
CANADA			
Catch	3,309,300	83,300	37,200
Share	13,460,600	6,125,400	306,000
Deviation:	-10,151,300	-6,042,100	-268,800

* From 2008 - 2017, United States allocation status follows either Commission guidance or Chapter 4 (paragraph 8, c, iv). This language states "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". Thus, in circumstances which satisfy the above conditions, the TAC's used to determine allocation status may be different than the TAC based on input data used in post-season calculations. The dates in each year used to calculate run sizes and other deductions for this allocation status table are noted in parathenses under each year. Exceptions to the language in paragraph 8, c, iv are noted below. Washinton shares during this period were calculated according to Annex IV of the Pacific Salmon Treaty: Shall not exceed 16.5% for Fraser River sockeye and 25.7% for Fraser River pink salmon.

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

2015: By Panel agreement, any U.S. catch of Fraser sockeye after August 7, when the last U.S. sockeye-directed fishery was scheduled, is considered an overage.

2016: No payback was generated in 2016, but by Panel agreement 900 sockeye were carried forward from the 2015 season.

2017: By Panel agreement 900 sockeye were carried forward from the 2015 season as well as the 1,500 sockeye overage generated from the 2017 season. U.S. pink salmon allocation status is based on TAC share in effect on Aug 31, when the last U.S. fishery was scheduled.

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 in 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

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

Spawning escapement target: Target for total adult spawning escapement for each spawning population as defined each year by Canada's Spawning Escapement Plan.

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

List of abbreviations:

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

APPENDIX B: 2017 PRE-SEASON FORECASTS AND SPAWNING ESCAPEMENT TARGETS FOR FRASER RIVER SOCKEYE AND PINK SALMON

Table B1. Pre-season forecasts for Fraser River sockeye and pink salmon in 2017. (Provided to the Panel by Fisheries and Oceans Canada).

A	F	G	H	I	J	K	L
Run timing group	**Mean Run Size**		**Probability that Return will be at/or Below Specified Run Size [a]**				
Stocks	**all cycles[b]**	**2017 cycle[c]**	**10%**	**25%**	**50%**	**75%**	**90%**
Early Stuart	**298,000**	**754,000**	**42,000**	**64,000**	**99,000**	**158,000**	**253,000**
Early Summer	--	--	**95,000**	**166,000**	**343,000**	**792,000**	**1,971,000**
(total excluding miscellaneous	**523,000**	**272,000**	**78,000**	**132,000**	**250,000**	**563,000**	**1,444,000**
Bowron	**37,000**	**23,000**	2,000	4,000	7,000	12,000	21,000
Fennell	**24,000**	**12,000**	5,000	8,000	14,000	25,000	43,000
Gates	**56,000**	**46,000**	15,000	25,000	49,000	96,000	197,000
Nadina	**75,000**	**67,000**	19,000	35,000	67,000	129,000	232,000
Pitt	**71,000**	**74,000**	35,000	52,000	84,000	140,000	227,000
Scotch	**116,000**	**22,000**	0	1,000	9,000	90,000	533,000
Seymour	**144,000**	**28,000**	2,000	7,000	20,000	71,000	191,000
Misc (Early Shuswap)[d]	--	--	1,000	2,000	7,000	24,000	71,000
Misc (Taseko)[d]	--	--	100	300	500	900	1,000
Misc (Chilliwack)	--	--	14,000	28,000	78,000	191,000	431,000
Misc (Nahatlatch) [e]	--	--	2,000	4,000	7,000	13,000	24,000
Summer	--	--	**1,065,000**	**1,861,000**	**3,407,000**	**6,631,000**	**12,560,000**
(total excluding miscellaneous	**3,873,000**	**6,546,000**	**1,048,000**	**1,826,000**	**3,348,000**	**6,508,000**	**12,312,000**
Chilko	**1,415,000**	**881,000**	663,000	1,168,000	2,142,000	4,090,000	7,588,000
Late Stuart	**527,000**	**1,564,000**	100,000	190,000	375,000	789,000	1,561,000
Quesnel	**1,304,000**	**3,726,000**	45,000	91,000	192,000	466,000	951,000
Stellako	**466,000**	**241,000**	174,000	247,000	355,000	503,000	734,000
Harrison [f & g]	**130,000**	**108,000**	52,000	109,000	251,000	603,000	1,390,000
Raft [f]	**31,000**	**26,000**	14,000	21,000	33,000	57,000	88,000
Misc (N. Thomp. Tribs) [f & h]	--	--	2,000	5,000	8,000	17,000	34,000
Misc (N. Thomp River) [f & h]	--	--	14,000	28,000	47,000	98,000	199,000
Misc (Widgeon) [i]	--	--	1,000	2,000	4,000	8,000	15,000
Late	--	--	**113,000**	**247,000**	**583,000**	**1,292,000**	**2,849,000**
(total exlcuding miscellaneous	**3,171,000**	**837,000**	**106,000**	**234,000**	**557,000**	**1,244,000**	**2,765,000**
Cultus	**37,000**	**14,000**	1,000	1,000	3,000	6,000	13,000
**Late Shuswap	**2,409,000**	**200,000**	12,000	58,000	174,000	444,000	1,027,000
Portage	**41,000**	**45,000**	8,000	20,000	51,000	139,000	331,000
Weaver	**332,000**	**282,000**	43,000	84,000	186,000	398,000	880,000
[xx]Birkenhead	**352,000**	**296,000**	42,000	71,000	143,000	257,000	514,000
Misc non-Shuswap [i]	--	--	7,000	13,000	26,000	48,000	84,000
TOTAL SOCKEYE SALMON	--	--	**1,315,000**	**2,338,000**	**4,432,000**	**8,873,000**	**17,633,000**
(TOTAL excluding miscellaneo	**7,865,000**	**8,409,000**	**1,274,000**	**2,256,000**	**4,254,000**	**8,473,000**	**16,774,000**
PINK SALMON	**12,400,000**		**4,447,000**	**6,177,000**	**8,693,000**	**12,353,000**	**16,682,000**

a. Probability that return will be at, or below, specified projection.
b. Sockeye: 1953-2014 (depending on start of time series)
c. Sockeye: 1953-2013 (depending on start of time series)
d. Misc. Early Shuswap stocks use forecsated Scotch and Seymour R/EFS; Misc. Taseko uses Chilko R/EFS in forecast
e. Misc. Nahatlach uses Early Summer Run stocks R/EFS in forecast
f. Raft, Harrison, Miscellaneous North Thompson stocks moved in current forecast to Summer Run timing group due to changes in run timing of these stocks
g. Harrison are age-4 (column C) and age-3 (column D).
h. Misc. North Thompson stocks use Raft & Fennel R/EFS in forecast
i. Misc. Late Run stocks (Harrison Lake down stream migrants including Big Silver, Cogburn, etc.), and river-type Widgeon use Birkenhead R/EFS in forecast

Table B2. Spawning escapement plan for Fraser River sockeye and pink salmon in 2017. (Provided to the Panel by Fisheries and Oceans Canada and based on Fraser River Sockeye Spawning Initiative (FRSSI) guidelines with input from domestic consultations).

Raft North Thompson & Harrison in Summer Run.

		Harvest Rule Parameters				
	Management Unit	Low Abundance ER (LAER)	TAM Cap	Lower Fishery Reference Point	Upper Fishery Reference Point	Pre-season pMA
	Early Stuart	10%	60%	108,000	270,000	0.89
	Early Summer (w/o misc)	10%	60%	100,000	250,000	0.39
	Summer (w/o misc)	10%	60%	1,250,000	3,125,000	0.06
	Late (w/o misc)	20%-30%	60%	300,000	750,000	0.92
Management		**Pre-season Forecast Return**				
Unit		p10	p25	**p50**	p75	p90
Early Stuart	forecast	42,000	64,000	**99,000**	158,000	253,000
	TAM Rule (%)	0%	0%	**0%**	32%	57%
	Escapement Target	42,000	64,000	**99,000**	108,000	108,000
	MA	37,400	57,000	**88,100**	96,100	96,100
	Esc. Target + MA	79,400	121,000	**187,100**	204,100	204,100
	LAER	10%	10%	**10%**	10%	10%
	ER at Return	0%	0%	**0%**	0%	19%
	Allowable ER	10%	10%	**10%**	10%	19%
	available harvest	4,200	6,400	**9,900**	15,800	48,900
	2017 Performance					
	Projected S (after MA)	20,000	30,500	**47,200**	75,400	108,200
	BY Spawners	86,311	86,311	**86,311**	86,311	86,311
	Proj. S as % BY S	23%	35%	**55%**	87%	125%
	cycle avg S	210,606	210,606	**210,606**	210,606	210,606
	Proj. S as % cycle S	9%	14%	**22%**	36%	51%
Management		**Pre-season Forecast Return**				
Unit		p10	p25	**p50**	p75	p90
Early Summer	lower ref. pt. (w misc)	137,200	137,200	**137,200**	137,200	137,200
(w/o RNT)	upper ref. pt. (w misc)	343,000	343,000	**343,000**	343,000	343,000
	forecast (incl. misc)	95,000	166,000	**343,000**	792,000	1,971,000
	TAM Rule (%)	0%	17%	**60%**	60%	60%
	Escapement Target	95,000	137,200	**137,200**	316,800	788,400
	MA	31,400	48,000	**53,500**	129,900	323,200
	Esc. Target + MA	126,400	185,200	**190,700**	446,700	1,111,600
	LAER	10%	10%	**10%**	10%	10%
	ER at Return	0%	0%	**44%**	44%	44%
	Allowable ER	10%	10%	**44%**	44%	44%
	available harvest	9,500	16,600	**152,300**	345,300	859,400
	2017 Performance					
	Projected S (after MA)	64,100	110,600	**137,300**	317,200	789,200
	BY Spawners	210,690	210,690	**210,690**	210,690	210,690
	Proj. S as % BY S	30%	52%	**65%**	151%	375%
	cycle avg S	81,685	81,685	**81,685**	81,685	81,685
	Proj. S as % cycle S	78%	135%	**168%**	388%	966%

Table B2, continued on next page

Table B2, continued.

Management Unit		Pre-season Forecast Return				
		p10	p25	**p50**	p75	p90
Summer (w. RNT & Har)	lower ref. pt. (w misc)	1,375,100	1,375,100	**1,375,100**	1,375,100	1,375,100
	upper ref. pt. (w misc)	3,437,750	3,437,750	**3,437,750**	3,437,750	3,437,750
	forecast	1,065,000	1,861,000	**3,407,000**	6,631,000	12,560,000
	TAM Rule (%)	0%	26%	**60%**	60%	60%
	Escapement Target	1,065,000	1,375,100	**1,375,100**	2,652,400	5,024,000
	MA	53,300	68,800	**82,500**	159,100	401,900
	Esc. Target + MA	1,118,300	1,443,900	**1,457,600**	2,811,500	5,425,900
	LAER	10%	10%	**10%**	10%	10%
	ER at Return	0%	22%	**57%**	58%	57%
	Allowable ER	10%	22%	**57%**	58%	57%
	available harvest	106,500	417,100	**1,949,400**	3,819,500	7,134,100
	2017 Performance					
	Projected S (after MA)	910,600	1,371,700	**1,370,100**	2,642,800	5,046,100
	BY Spawners	1,928,582	1,928,582	**1,928,582**	1,928,582	1,928,582
	Proj. S as % BY S	47%	71%	**71%**	137%	262%
	cycle avg S	1,577,700	1,577,700	**1,577,700**	1,577,700	1,577,700
	Proj. S as % cycle S	58%	87%	**87%**	168%	320%

Management Unit		Pre-season Forecast Return				
		p10	p25	**p50**	p75	p90
Late (w/o Har)	lower ref. pt. (w misc)	314,000	314,000	**314,000**	314,000	314,000
	upper ref. pt. (w misc)	785,000	785,000	**785,000**	785,000	785,000
	forecast	113,000	247,000	**583,000**	1,292,000	2,849,000
	TAM Rule (%)	0%	0%	**46%**	60%	60%
	Escapement Target	113,000	247,000	**314,000**	516,800	1,139,600
	MA	84,800	210,000	**288,900**	496,100	1,139,600
	Esc. Target + MA	197,800	457,000	**602,900**	1,012,900	2,279,200
	LAER	20%	20%	**20%**	30%	30%
	ER at Return	0%	0%	**0%**	22%	20%
	Allowable ER	20%	20%	**20%**	30%	30%
	available harvest	22,600	49,400	**116,600**	387,600	854,700
	2017 Performance					
	Projected S (after MA)	51,500	106,700	**242,500**	461,200	997,200
	BY Spawners	321,018	321,018	321,018	321,018	321,018
	Proj. S as % BY S	16%	33%	**76%**	144%	311%
	cycle avg S	177,190	177,190	**177,190**	177,190	177,190
	Proj. S as % cycle S	29%	60%	**137%**	260%	563%
Available Harvest (TF, US, CDN)		142,800	489,500	**2,228,200**	4,568,200	8,897,100
Total projected spawners		1,046,200	1,619,500	**1,797,100**	3,496,600	6,940,700

Fraser River pink salmon spawning escapement target plan

7,059,000	Lower Fishery Reference Point
20,000,000	Upper Fishery Reference Point
70%	Maximum Exploitation Rate

	Pre-season Forecast Return				
	p10	**p25**	**p50**	**p75**	**p90**
forecast	4,447,000	6,177,000	8,693,000	12,353,000	16,682,000
escapement target	4,027,000	5,366,000	6,000,000	6,000,000	6,000,000
allowable ER	9%	13%	31%	51%	64%

APPENDIX C: 2017 FRASER RIVER PANEL MANAGEMENT PLAN PRINCIPLES AND CONSTRAINTS (agreed July 7, 2017)

1. Fisheries and Oceans Canada (DFO) has provided the Panel with run-size forecasts for Fraser River sockeye and pink salmon. It is broadly understood that the sockeye and pink run-size forecasts are associated with relatively 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 4,432,000 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 2,338,000 fish and there is a one in four chance that the actual number of returning sockeye will be at or larger than 8,873,000 fish. By stock grouping, the median or 50% probability forecasts are 99,000 Early Stuart, 343,000 Early Summer-run, 3,407,000 Summer-run, and 583,000 Late-run sockeye. The 50% probability level forecast for Fraser river pink salmon is 8,693,000 fish. To put the uncertainty around the pink salmon forecast into context, there is a one in four chance that the actual return of pink salmon will be below 6,177,000, and a one in four chance that the return will be larger than 12,353,000. The 50% probability level abundance forecasts for Fraser River sockeye and pink 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 and pink 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. As a result of the pre-season planning and with consideration of the potential for adverse environmental conditions for fish survival and productivity, neither Canada nor the US anticipates harvesting their full sockeye salmon total allowable catches (TACs). However, depending upon sockeye and coho constraints both Canada and the United States anticipate harvesting the full pink salmon TAC if Fraser River pink salmon returns in 2017 correspond to the p50 forecast level.

3. TACs and international shares are calculated according to the 2014 revised Annex IV, Chapter 4, of the Pacific Salmon Treaty, which limits the United States harvest (in Washington State) to 16.5% of the TAC of Fraser River sockeye salmon and 25.7% of the TAC of Fraser River pink salmon. Based upon the 50% probability levels of abundance, for the purposes of computing Fraser River sockeye TAC by stock management grouping in 2017, the Panel agreed to pre-season Fraser River Aboriginal Exemptions as follows: Early Stuart sockeye, 9,600 fish; Early Summer-run sockeye, 25,900 fish; Summer-run sockeye, 347,200 fish; and Late-run sockeye, 17,300 fish. In situations where the allowable harvest of 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 available TAC in other Fraser River sockeye salmon management groups and/or Fraser River pink salmon. At the 50% probability forecasts, the LAERs are set at 10% for Early Stuart, Early Summer and Summer-run sockeye, and at 20-

30% for 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 that presumes that similar to recent years, Late-run sockeye will enter the Fraser River earlier than the long-term average, and some proportion will not survive to spawn.

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 0.92. If in-season information suggests that the upstream timing of the Late-run excluding Birkenhead is later than September 9th, the Panel will consider adjusting the management adjustment factor based on predictions from the timing model fit to all years. No direct harvest of Late-run sockeye is planned at the p50 run size forecast. However, some limited by-catch of Late-run sockeye may occur in fisheries directed at other Fraser sockeye management groups with harvestable surpluses and Fraser River pink salmon. If the return of Late-run sockeye is less than the 75% probability level forecast (1,292,000 fish) the by-catch of Late-run sockeye will be limited to a maximum exploitation rate of 20% and if their return is greater than or equal to the 75% probability level forecast, the maximum exploitation rate is 30%.

Regulations

i) If in-season conditions are consistent with pre-season expectations, low impact fisheries would be expected to commence during mid-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 2017 management season.

APPENDIX D: 2017 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 16, 2017.

Canadian Fraser River Panel Area

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

1. a) No person shall commercially fish for sockeye or pink salmon in Pacific Fishery Management Area 20-1, 3 and 4 with nets from the 25th day of June, 2017, to the 16th day of September, 2017, both dates inclusive.

   b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 20-1, 3 and 4 from the 25th day of June, 2017, to the 16th day of September, 2017, both dates inclusive.

2. a) No person shall commercially fish for sockeye or pink salmon in Pacific Fishery Management Areas 17 and 18 with nets from the 25th day of June, 2017 to the 30th day of September, 2017, both dates inclusive.

   b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 18-1, 4 and 11 from the 25th day of June, 2017, to the 30th day of September, 2017, both dates inclusive.

3. a) No person shall commercially fish for sockeye or pink salmon with nets in Pacific Fishery Management Area 29 from the 25th day of June, 2017, to the 14th day of October, 2017, both dates inclusive.

   b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 29 from the 25th day of June, 2017, to the 14th day of October, 2017, 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.

During the 2017 season, the Fraser River Panel will adopt orders establishing open fishing periods based on a 2017 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 to the United States Government the adoption of the following Fishing Regime developed by the Fraser River Panel, namely:

Treaty Indian Fisheries:

1. No Treaty Indian shall commercially fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 4B, 5 and 6C with drift gillnets or purse seines from the 25th day of June, 2017 to the 16th day of September, 2017, both dates inclusive.

2. No Treaty Indian shall commercially fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 6, 6A, 7 and 7A with nets from the 25th day of June, 2017, to the 30th day of September, 2017, both dates inclusive.

3. No Treaty Indian shall commercially fish for sockeye or pink salmon with nets in that portion of Puget Sound Salmon Management and Catch Reporting Area 7A lying westerly of a straight line drawn from the low water range marker in Boundary Bay on the International Boundary through the east tip of Point Roberts in the State of Washington to the East Point Light on Saturna Island in the Province of British Columbia from the 1st day of October, 2017, to the 7th day of October, 2017, both dates inclusive.

All-Citizen Fisheries:

1. No person shall fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 4B, 5, and 6C with nets from the 25th day of June, 2017, to the 16th day of September, 2017, both dates inclusive.

2. No person shall fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 6, 6A, 7 and 7A with nets from the 25th day of June, 2017, to the 30th day of September, 2017, both dates inclusive.

3. No person shall fish for sockeye or pink salmon with nets in that portion of Puget Sound Salmon Management and Catch Reporting Area 7A lying westerly of a straight line drawn from the low water range marker in Boundary Bay on the International Boundary through the east tip of Point Roberts in the State of Washington to the East Point Light on Saturna Island in the Province of British Columbia from the 1st day of October, 2017, to the 7th day of October, 2017, both dates inclusive.

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

Treaty Indian 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 2017 season, the Fraser River Panel will adopt orders establishing open fishing periods based on a 2017 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: 2017 Pre-Season Agreement on Test Fishing Deductions and use of the Test Fishing Revolving Fund (Agreed July 25, 2017[15])

Purpose: The Pacific Salmon Commission (PSC) conducts test fisheries to assess various factors pertinent to the conservation and management of Fraser River sockeye and pink salmon. Revenue for the program is generated through sale of fish retained by test-fisheries. Some of the fish retained are either unavoidably killed in the conduct of test fishing operations or required for biological samples, and the retention of additional fish ("pay fish") provides revenues to offset larger program costs. The PSC maintains a "Test-Fishing Revolving Fund" (TFRF) that was created from the combination of contributions from Canada and the United States and surplus revenues generated from the sale of fish caught in Panel Area waters. The purpose of the fund is to ensure that sufficient resources are available to cover the cost of the test-fishing program in the event that conservation needs prevent retention of adequate numbers of sockeye, pink, and saleable by-catch to offset the cost of the program. For 2017, the forecast and pre-season fishing plans project sufficient international Total Allowable Catch (TAC) such that the taking of "pay fish" is planned to cover test fishing program costs. Based on these pre-season projections, it is anticipated that the Fraser sockeye TAC will fully meet Canada's First Nations allocations for Food, Social and Ceremonial (FSC) purposes. However, should in-season information suggest that the return of Fraser sockeye is not sufficient to fully meet Canada's obligation for FSC fisheries, allocation issues within Canada prevent the retention of "pay fish". For this reason, and to address this issue for 2017 only, the Parties have agreed to the following approach for the 2017 season, without prejudice to future arrangements:

1. If during the season international TAC is determined to be below the level that Canada needs to meet its First Nations FSC allocations, only those salmon (and other incidentally caught fish) that are unavoidably killed or required for biological samples in Panel-approved test fisheries will be landed and sold, unless otherwise specified below or agreed by the Parties.

2. Where in-season the Fraser River Panel determines that sockeye aggregate harvestable surplus (defined as the sum of run sizes minus escapement targets, minus management adjustments, and minus the agreed test fishing deductions for each stock management group) is sufficient to support an international total allowable catch (TAC; as defined in paragraph 3, Annex IV, Chapter 4 of the Pacific Salmon Treaty), but insufficient to support Canada's full domestic allocations to First Nations FSC purposes (1,079,000 Fraser River sockeye which includes the 400,000 Aboriginal Fisheries Exemption), the Parties agree that any resulting funding deficits in the test fishing program will be paid from the PSC Test Fishing Revolving Fund (TFRF). The Secretariat will maintain timely records of the deficits incurred, and apportion those deficits between the Parties in proportion to their Fraser River sockeye TAC shares (i.e. 16.5% to the United States and 83.5% to Canada) after the conclusion of the sampling season.

3. Where in-season the Fraser River Panel determines aggregate sockeye harvestable surplus is sufficient to support both an international TAC and the full FSC allocations to Canada's First Nations, the Panel will prioritize the harvest, landing, and sale of salmon in Panel-approved test fisheries beyond those identified in paragraph 1, with the goal of recovering revenues to offset some or all of costs incurred in the 2017 season. Any fish so harvested will be added to the existing test fishing harvests and deducted from the international TAC as per normal practice. The Secretariat will maintain timely records of the deficits incurred, and apportion those deficits between the Parties in proportion to their Fraser River sockeye TAC shares (i.e. 16.5% to the United States and 83.5% to Canada) after the conclusion of the sampling season.

[15] Agreed in principle July 25, 2017, text finalized November 6, 2017

4. Where in-season the Fraser River Panel determines that aggregate sockeye harvestable surplus is insufficient to generate an international TAC, any shortfalls in revenues relative to program costs will be recovered from the TFRF. The Secretariat will maintain timely records of the deficits incurred, and apportion those deficits against contributions made by the countries to the TFRF between the Parties equally (i.e. 50:50) after the conclusion of the sampling season.

APPENDIX F: 2017 FRASER RIVER PANEL IN-SEASON ORDERS

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

August 22, 2017

United States

Treaty Indian

Areas 4B, 5 and 6C

Open to drift gillnets from 12:00 p.m. (noon), Wednesday, August 23, 2017 through 12:00 p.m. (noon) Saturday, August 26, 2017. Sockeye may be retained for ceremonial and subsistence purposes only.

Areas 7

Open to reefnets 5:00 a.m. to 9:00 p.m., Wednesday, August 23, 2017, 5:00 a.m. to 9:00 p.m., Thursday, August 24, and 5:00 a.m. to 9:00 p., Friday, August 25, 2017. Sockeye may be retained for ceremonial and subsistence purposes only.

August 24, 2017

United States

Treaty Indian

Areas 7

Open to reefnets 5:00 a.m. to 9:00 p.m., Saturday, August 26, 2017. Sockeye may be retained for ceremonial and subsistence purposes only.

Areas 6, 7 and 7A

Open to purse seines and gillnets from 5:00 a.m., Friday August 25, 2017 to 9:00 a.m., Saturday, August 26, 2017. Sockeye may be retained for ceremonial and subsistence purposes only.

All Citizen

Areas 7 and 7A

Open to reefnets with non-retention of sockeye, 5:00 a.m. to 9:00 p.m., Friday, August 25, 2017 and 5:00 a.m. to 9:00 p.m., Saturday, August 26, 2017.

August 25, 2017

United States

Treaty Indian

Areas 4B, 5 and 6C

As previously announced, open to drift gillnets from 12:00 p.m. (noon), Wednesday, August 23, 2017 to 12:00 p.m. (noon) Saturday, August 26, 2017. Sockeye may be retained for ceremonial and subsistence purposes only.

Areas 7

As previously announced, open to reefnets 5:00 a.m. to 9:00 p.m., Saturday, August 26, 2017. Sockeye may be retained for ceremonial and subsistence purposes only.

Areas 6, 7 and 7A

As previously announced, open to purse seines and gillnets from 5:00 a.m., Friday August 25, 2017 to 9:00 a.m., Saturday, August 26, 2017. Sockeye may be retained for ceremonial and subsistence purposes only.

All Citizen

Areas 7 and 7A

As previously announced, open to reefnets with non-retention of sockeye, 5:00 a.m. to 9:00 p.m., Friday, August 25, 2017 and 5:00 a.m. to 9:00 p.m., Saturday, August 26, 2017.

August 28, 2017

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Open to drift gillnets from 12:00 p.m. (noon), Tuesday, August 29, 2017 to 12:00 p.m. (noon) Friday, September 1, 2017. Sockeye may be retained for ceremonial and subsistence purposes only.

Areas 6, 7 and 7A

Open to purse seines and drift gillnets from 5:00 a.m., Wednesday, August 30, 2017, to 9:00 a.m., Thursday August 31, 2017. Sockeye may be retained for ceremonial and subsistence purposes only.

Areas 7

Open to reefnets from 5:00 a.m. to 9:00 p.m., Tuesday, August 29, 2017 and from 5:00 a.m. to 9:00 p.m., Wednesday, August 30, 2017. Sockeye may be retained for ceremonial and subsistence purposes only.

All Citizen

Areas 7 and 7A

Open to purse seines with non-retention of sockeye, from 5:00 a.m. to 9:00 p.m., Tuesday, August 29, 2017.

Areas 7 and 7A

Open to gillnets, with non-retention of sockeye, from 8:00 a.m. to 11:59 p.m., Tuesday, August 29, 2017.

Areas 7 and 7A

Open to reefnets with non-retention of sockeye, from 5:00 a.m. to 9:00 p.m., Tuesday, August 29, 2017, and from 5:00 a.m. to 9:00 p.m., Wednesday, August 30, 2017.

August 31, 2017

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extend for drift gillnets from 12:00 p.m. (noon), Friday, September 1, 2017 to 12:00 p.m. (noon) Tuesday, September 5, 2017. Sockeye may be retained for ceremonial and subsistence purposes only.

Areas 6, 7 and 7A

Open to net fishing, excluding reefnets from 5:00 a.m., Friday, September 1, 2017, to 9:00 p.m., Tuesday September 5, 2017. Sockeye may be retained for ceremonial and subsistence purposes only.

Areas 7 and 7A

Open to reefnets from 5:00 a.m. to 9:00 p.m., daily from Friday, September 1, 2017 through Tuesday, September 5, 2017. Sockeye may be retained for ceremonial and subsistence purposes only.

All Citizen

Areas 7 and 7A

Open to purse seines with non-retention of sockeye, from 5:00 a.m. to 9:00 p.m., daily from Friday, September 1, 2017, through Tuesday, September 5, 2017.

Areas 7 and 7A

Open to drift gillnets with non-retention of sockeye, from 8:05 a.m. to 11:59 p.m., daily from Friday, September 1, 2017, through Tuesday, September 5, 2017.

Areas 7 and 7A

Open to reefnets with non-retention of sockeye, from 5:00 a.m. to 9:00 p.m., daily from Friday, September 1, 2017, through Tuesday, September 5, 2017.

Areas 7 and 7A

Open to beach seines, with non-retention of sockeye, from 5:00 a.m., Friday, September 1 through 9:00 p.m., Tuesday, September 5, 2017.

September 5, 2017

United States

Treaty Indian Fishery

Areas 6, 7 and 7A

Open to net fishing, excluding reefnets from 5:00 a.m., Friday, September 1, 2017, to 9:00 p.m., Sunday September 3, 2017. Sockeye may be retained for ceremonial and subsistence purposes only.

Areas 7 and 7A

Open to reefnets from 5:00 a.m. to 9:00 p.m., daily from Friday, September 1, 2017 through Sunday, September 3, 2017. Sockeye may be retained for ceremonial and subsistence purposes only.

All Citizen

Areas 7 and 7A

Open to purse seines with non-retention of sockeye, from 5:00 a.m. to 9:00 p.m., daily from Friday, September 1, 2017, through Sunday, September 3, 2017.

Areas 7 and 7A

Open to drift gillnets with non-retention of sockeye, from 8:05 a.m. to 11:59 p.m., daily from Friday, September 1, 2017, through Sunday, September 3, 2017.

Areas 7 and 7A

Open to reefnets with non-retention of sockeye, from 5:00 a.m. to 9:00 p.m., daily from Friday, September 1, 2017, through Sunday, September 3, 2017.

Areas 7 and 7A

Open to beach seines, with non-retention of sockeye, from 5:00 a.m., Friday, September 1, 2017, through 11:59 p.m., Sunday, September 3, 2017.

September 12, 2017

United States

Areas 6, 6A and 7

Relinquish regulatory control effective (12:01 a.m.) Sunday, September 24, 2017.

Fraser River Panel control of Canadian Panel Areas was relinquished in accordance with the pre-season Regulations (Appendix D) as follows: Area 20 on September 16; Areas 17 and 18 on September 30; and Area 29 on October 14. Panel control of United States Panel Areas were relinquished as follows; Areas 4B, 5 and 6C on September 16 in accordance with the pre-season Regulations; Areas 6, 6A and 7 on September 24 by in-season order, and the remaining portions of Area 7A on October 7 in accordance with the pre-season Regulations.

APPENDIX G: 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 sockeye and pink salmon, including abundance-related data such as catch-per-unit-effort (CPUE) and biological samples from which stock composition estimates are obtained. While Table 3 in the main body of the report summarizes the locations and temporal patterns of Panel-approved test fisheries, Table G1 summarizes more detailed information about the nets and sampling strategies employed.

Table G 1. Sampling details for Panel-approved test fisheries conducted in 2017.

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

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

2 Round Island vessels used a 60 mesh nylon net.

Information pertaining to the migration of Fraser River sockeye and pink salmon through marine areas is provided primarily by test fisheries in Area 20 (Juan de Fuca Strait) and Areas 12 and 13 (upper and lower Johnstone Strait). For Fraser River pink salmon, CPUE and stock composition data from the seine test fisheries in Areas 20 and 12 are particularly important for estimating total abundance. Test fisheries in the Fraser River (Area 29) are used to assess species and stock composition for application to Mission passage estimates. When the Mission hydroacoustic program is not active or when high abundances of pink salmon confound estimates

of sockeye proportions migrating upstream, lower river (Area 29) test fisheries provide passage estimates for sockeye salmon through the use of CPUE models.

In 2017, the Fraser River Panel tried to minimize the duration and cost of Panel-approved test fisheries. Also, as a result of the low forecast for Early Stuart sockeye (p50: 99,000 sockeye), the Area 20 gillnet test fishery start date was delayed until July 7th, and the Area 12 gillnet test fishery start date was delayed until July 11th, after which most of the Early Stuart sockeye were thought to have migrated past the test fishery sites. The test fishing program was reduced for 2017 to reflect what was considered to be the main test fisheries required for quantitative in-season run size assessments. The number of Area 20 gillnet test fishing vessels was reduced from two to one (this also occurred in 2016), the Area 12 Naka Creek gillnet test fishery was cancelled, the number of reefnet observation days was reduced to operate only prior to potential U.S. commercial fishery openings, and the Area 5 U.S. gillnet test fishery was cancelled for 2017.

Early in the season, daily marine gillnet catches were low compared to brood year catches, and remained below the cycle year average. Later in the season, purse seine test fishery catches were also low compared to the brood years as well as the cycle year average. In the Fraser River, test fishing catches were lower than the brood year as well as the cycle year average with Cottonwood catches not exceeding 50 sockeye/day except on August 17th and 18th and Whonnock catches not exceeding 60 sockeye/day, except on August 21st and 22nd. At Cottonwood, the electric net (used in the past for seal deterrence) was no longer used; due to this change, the net was less cumbersome and two 20 minute sets were made per day instead of one 30 minute set, as had been done in recent years (2010 to 2016). Only sockeye caught in gillnet test fisheries and those kept for biological samples were retained and sold for revenue to partially recover program costs. Pink payfish were caught in the marine purse seines, but only on days when keeping extra pink salmon would not necessitate keeping more sockeye than needed for sampling. The total number of Fraser River sockeye retained from all Panel approved test fisheries was approximately one third of what was originally expected, and the same was true for pink salmon. Despite relatively strong prices for sockeye and pink salmon, fish sales were inadequate to fully fund program activities in 2017 (the deficit was $530,000, and would be covered by the Test Fish Revolving fund).

2017 was the second year of a three year Southern Endowment and Enhancement Committee approved project [16]. The project utilizes Global Positioning Satellite tracking technology to collect tide and current data and evaluate the effects of tide and current, in upper Johnstone Strait in the vicinity of the Area 12 Blinkhorn purse seine test fishery, on the catch-per-unit effort of Fraser sockeye in test fisheries. The project goal is to improve run-size abundance estimates derived from marine test fishery data. The data collected will augment other test fishery data that are used to assess Fraser sockeye run sizes. This project is supported by PSC Secretariat and DFO assessment staff.

B. Mission Hydroacoustics

A hydroacoustics monitoring station is operated by PSC Staff upstream of the Mission Railway Bridge from July through September to provide accurate and timely estimates of sockeye and pink salmon passage through the lower Fraser River. Since the 2011 season, Staff have implemented a standardized sampling method to estimate daily salmon passage using a

[16]Michielsens, C., M. Shimomura, C. McConnell, R. Goruk, M. Lapointe, and K. Forrest. 2017. Deployment of ocean surface current trackers in upper Johnstone Strait for the collection of local tide and current data to explain variability in marine catch data and improve daily abundance and run size estimates of Fraser River Sockeye & Pink salmon: A project report to Southern boundary restoration and enhancement fund. Pacific Salmon Commission, Vancouver, British Columbia. February, 2018.

combination of split-beam and imaging sonars[17,18]. The sonar systems operate 24 hours a day to collect information on the density, direction of travel, speed, and size distributions of fish targets. For 2017, daily salmon passage was estimated using a side-looking split-beam sonar system on the left bank of the river, a downward-looking split-beam sonar mounted on a vessel transecting the river, and an imaging sonar, **D**ual frequency **ID**entification **SON**ar (DIDSON), on the right bank of the river (Figure G1). An **A**daptive **R**esolution **I**maging **S**onar, (ARIS) was also operated on the left bank directly adjacent to the split-beam sonar to verify passage estimates and provide information on species composition.

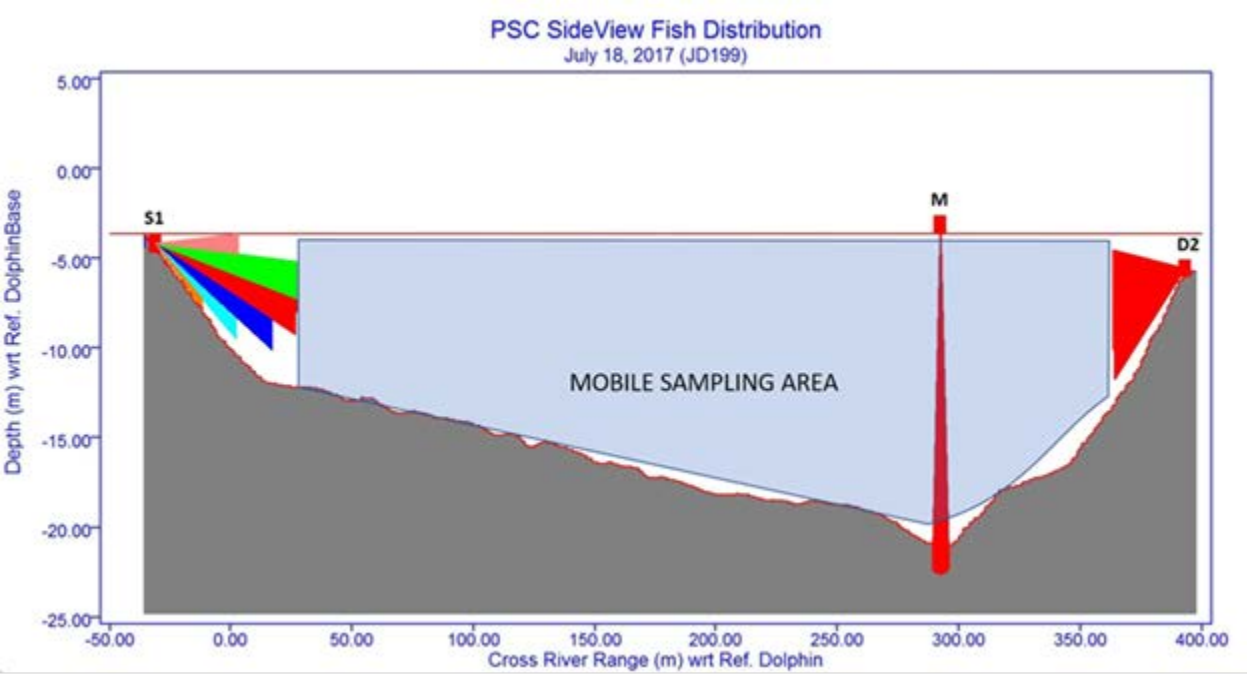

Figure G1. Cross-river view of the sampling geometry of the sonar systems operated at the Mission hydroacoustics site. The three systems shown are the left bank split-beam (S1), the mobile split-beam (M), and the right bank DIDSON (D2). The left bank ARIS (A1) is not shown but was deployed in the same location as the left bank split-beam. The blue filled area represents the cross-river region sampled by the mobile split-beam. The gray filled area represents the river bottom profile. Note that the horizontal cross-river range on the x-axis is compressed relative to the vertical depth on the y-axis.

The left bank split-beam (S1) consists of a side-looking transducer with an elliptical beam width of 2°×10° manufactured by Hydroacoustics Technology Incorporated (HTI). The transducer was attached to a SIDUS SS250 rotator to control its pan and tilt, allowing stratified sampling of the water column by the narrow vertical beam. The stratified sampling design consisted of six non-overlapping, 2° vertical fan-shaped sectors with each sector sampling for 10 minutes each hour up to a range of 60 metres. This sampling design was intended to maximize the

[17] Xie, Y., A. P. Gray, F. J. Martens, and J. D. Cave. 2007. Development of a shore-based hydroacoustics system on the right bank of the Lower Fraser River to monitor salmon passages: A project report to Southern boundary restoration and enhancement fund. Pacific Salmon Commission, Vancouver, British Columbia. April, 2007.

[18] Xie, Y., F. J. Martens, C. G. Michielsens, J. D. Cave. 2013. Implementation of Stationary Hydroacoustic Sampling Systems to Estimate Salmon Passage in the Lower Fraser River: A final project report to the southern boundary restoration and enhancement fund. Pacific Salmon Commission, Vancouver, British Columbia. May, 2013.

portion of water column insonified by the sonar, therefore minimizing unsampled areas where migratory abundance must be estimated by extrapolation. The aim and orientation of the transducer were monitored and verified using a Thinksensor TSR-100 motion reference unit. The split-beam system was deployed towards the far end of an extendable fish-deflection weir which prevented fish from swimming behind or too close to the transducer. The system was operated for the full duration of the hydroacoustics program from July 7 to September 25.

From July 7 to September 19 an ARIS system (A1) was also operated on the left bank from a location adjacent to the left bank split-beam at the end of the fish-deflection weir. The ARIS system was deployed on a rotator unit that allowed it to cycle through multiple vertical aims for full sampling coverage of the water column up to a range of 40 metres. Data collected by the ARIS was used to validate the daily estimates of salmon passage from the left bank split-beam and for measuring fork lengths of fish migrating through the left bank area, which was in turn used to estimate the relative proportions of pink salmon and sockeye salmon. This was the first year that an ARIS was deployed on the left bank for the entirety of the season instead of a DIDSON. However, unlike recent pink return years, the left bank imaging sonar was not adopted for the official estimate of salmon passage during the peak pink migration because there was no evidence of saturation of the split-beam.

The vessel-based split-beam system (M) was operated from July 7 to September 25 using a downward-looking transducer with a 6° circular beam manufactured by Biosonics Incorporated. The transducer was towed by a vessel along transects perpendicular to the river flow to obtain cross-river fish density data in offshore areas. Each transect took approximately five minutes from one bank of the river to the other and an average of 170 transects were carried out each day. Information on the direction of travel and speed of fish targets cannot be obtained from a moving transducer, so behavioural statistics observed from the left bank split-beam were applied to the vessel-based density data to estimate offshore fish passage[19]. To validate estimated offshore fish passage by the mobile sampling system, a vessel-based DIDSON was also deployed for approximately 6 hours per day from anchored positions near the left or right bank. The DIDSON was aimed offshore for stationary sampling of fish passage up to a range of 20 metres from the vessel.

The right bank inshore DIDSON (D2) commenced data collection on July 13 and was included in subsequent daily estimates of salmon passage up to September 24. This DIDSON was also deployed near the end of a fish deflection weir to prevent fish from swimming behind or too close to the sonar. The river bottom profile near the right bank follows a slightly concave profile that is well-suited to the vertical beam shape of the DIDSON, allowing the sonar to sample the entire water column up to 30 metres from the shoreline using a single, fixed aim pointing approximately 5° downwards.

To determine salmon passage in areas sampled by the DIDSON and ARIS systems, a subset of the imaging data was manually counted by trained technicians. Technicians counted the number of fish targets and their direction of travel for 5 to 10 minutes of each hour within 10 metre sampling strata. These counts were then expanded to estimate the hourly passage of fish in both the upstream and downstream directions. Since these counts included small, resident fish, a normally-distributed mixture model was applied to apportion the salmon passage from the total passage of fish for each day. The mixture model estimated the proportion of each salmon species and resident fish species based on fork length measurements from a subset of the same imaging data used for counting fish passage.

[19] Xie, Y., A. P. Gray, F. J. Martens, J. L. Boffey and J. D. Cave. 2005. Use of dual-frequency identification sonar to verify salmon flux and to examine fish behaviour in the Fraser River. Pacific Salmon Comm. Tech. Rep. No. 16: 58 p. Vancouver, B.C.

To determine salmon passage sampled by the split-beam systems, acoustic echoes were tracked using an alpha-beta tracker[20] and then classified as fish or noise (e.g. debris, air bubbles) by a discriminate function analysis[21]. This treatment also removed small, non-salmonid fish targets from the estimation data by filtering out echoes that were too weak to represent adult salmon. The integrity of statistically identified fish tracks was further verified by trained staff that reviewed the echogram data with editing software to remove misclassified targets. This processing procedure was performed each day for the data collected from both the left bank and vessel-based split-beam systems providing information on the density and position of fish targets within the areas sampled by both systems. Processed fish tracks from the stationary left bank system also provided information on the velocity and direction of travel of fish targets.

The daily total salmon passage was estimated by adding the salmon passage estimates from the left bank split-beam, the vessel-based split-beam and the right bank DIDSON. Since there is some overlap in sampling areas between the vessel-based split-beam and the shore-based systems in nearshore areas, the overlapped sampling areas were identified using GPS and only passage estimates from the shore-based systems were included in the daily total estimate for these areas. Estimates from the shore-based systems were preferentially adopted because the vessel-based split-beam estimates are the least precise due to lower sampling intensity.

Salmon passage estimates were apportioned among Pacific salmon species based on daily catch proportions from the Whonnock gillnet test fishery, historic escapement estimates, as well as fish length measurements on DIDSON and ARIS data. Species proportions were based primarily on test fishing catches up until July 31 when pink salmon started migrating through the river. Due to their very nearshore oriented migration behaviour, pink salmon are less susceptible to offshore gillnets than sockeye, therefore species proportions derived from gillnet test fisheries may fail to represent the true proportions of salmon species when pink salmon are present in significant numbers. To estimate the proportion of pink and sockeye salmon during their co-migration period after July 31, a stratified estimation method was implemented with species proportions in offshore areas based on catch from the Whonnock test fishery and nearshore species proportions based on fish length measurements from imaging sonar data[22]. These daily length measurements were input to a mixture model that estimated the proportion of pink and sockeye salmon based on the fit of the length data to normal distributions for each species using fixed mean lengths and coefficients of variation[23]. The mean length of sockeye and pink salmon for the mixture model was estimated from biological length measurements of catch from Whonnock and the LGL fish wheel program[24]. The stratified method for species proportions was applied to the total daily salmon estimate to determine pink and sockeye passage from July 31 to August 24. From August 25 and onward, salmon passage at Mission was dominated by pink salmon, reducing the reliability of mixture model estimates of sockeye and pink salmon proportions. Therefore, daily sockeye abundance during this period was estimated by expanding Whonnock CPUE estimates using a catchability coefficient. Pink salmon passage was then estimated as total salmon passage minus sockeye and Chinook passage estimates.

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[20] Blackman, S. S. and R. Popoli. Design and Analysis of Modern Tracking Systems. Artech House, Boston, 1999.

[21] Xie, Y., C.G.J. Michielsens, and F.J. Martens. 2012. Classification of fish and non-fish acoustic tracks using discriminant function analysis. – ICES Journal of Marine Science, doi:10.1093/icesjms/fsr198

[22] 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.

[23] Xie, Y., F. J. Martens, Catherine G. J. Michielsens and James D. Cave. 2013. Implementation of Stationary Hydroacoustic Sampling Systems to Estimate Salmon Passage in the Lower Fraser River: *A final project report to the southern boundary restoration and enhancement fund.* Pacific Salmon Commission. May, 2013.

[24] Robichaud, D, J.J. Smith, K.K. English, and S.C. Tyerman. 2011. Survival and Timing of Sockeye Returns to the Fraser River Assessed using Fishwheels, Radio-telemetry and Additional Monitoring of In-river Fisheries, 2010. Report prepared for Pacific Salmon Commission. April, 2011.

The 2017 hydroacoustics program also included data exchanges with DFO to compare Mission daily passage estimates to passage estimates from a hydroacoustics site further upstream on the Fraser River at Qualark Creek. The Qualark hydroacoustics site was operated by DFO and received funding from the Southern Endowment Fund. Funding by the Southern Endowment Fund was also provided to the Mission hydroacoustics program to reprofile the river bottom in the left bank area that is sampled by the shore-based split-beam and ARIS systems[25].

Stock Identification

PSC staff conduct sampling programs designed to identify stock proportions of Fraser River sockeye and pink salmon in commercial, test, First Nations and recreational catches. Coupled with abundance indices from stock monitoring programs, these data provide information on the abundance and timing of sockeye and pink salmon stocks as they migrate to their natal rivers in the Fraser watershed. Stock identification data are also 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 2017 used DNA and scale pattern analyses from fish caught in marine and in-river fisheries. 2017 was the sixth year that stock identification for pink salmon relied on DNA analyses rather than the protein electrophoretic techniques used previously; these analyses were applied to mixtures sampled in marine fisheries. For both sockeye and pink 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. For pink salmon, these extrapolations use stock composition estimates from previous years in addition to the stock proportions estimates from current year catches. For sockeye salmon, only samples from 2017 catches were used.

A. Sockeye Salmon

Stock identification methods for sockeye salmon relied on DNA[26] (using the program CBAYES[27]) and scale pattern analyses[28]. 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”). Samples from test fishery catches were analyzed daily, beginning in early July and continuing to mid-September. PSC staff sampled sockeye from most test fishery catches from Port Renfrew and the lower Fraser River in British Columbia. 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.

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[25] Lagasse, C.R., M. Bartel-Sawatzky, J.L. Nelitz, and Y. Xie. 2018. River Bottom Modification for Improved Hydroacoustic Enumeration of Fraser Sockeye and Pink Salmon at the Mission Site: A Final Project Report to the Southern Boundary Restoration and Enhancement Fund. Pacific Salmon Commission. April 2018.

[26] Beacham, T.D., M. Lapointe, J.R. Candy, B. McIntosh, C. MacConnachie, A. Tabata, K. Kaukinen, L. Deng, K.M. Miller and R.E. Withler. 2004. Stock identification of Fraser River sockeye salmon using microsatellites and major histocompatibility complex variation. Trans. Am. Fish. Soc. 133: 1117-1137.

[27] Neaves, P.I., C.G. Wallace, J.R. Candy, and T.D. Beacham. 2005. CBAYES: Computer program for mixed stock analysis of allelic data, v5.01. Department of Fisheries and Oceans (Canada). Available: http://www.pac.dfo-mpo.gc.ca/science/facilities-installations/pbs-sbp/mgl-lgm/apps/index-eng.htm (January 2012).

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

Sockeye catches in District 104 totaled 98,204 of which preliminary DNA analyses suggest 18,700 were of Fraser origin.

B. Pink Salmon

Pink salmon mixtures are apportioned into three components – Fraser River, Canada South Coast (excluding Fraser) and Washington. Estimation is made possible through the analysis of baseline genetic information that has been collected from numerous stocks from each region. In 2017, the baseline was composed similarly to other recent years with pink salmon stocks from the three regions as follows: (1) Fraser River – lower Fraser mainstem, Vedder, Harrison, Weaver, Chehalis, Coquihalla, Nahatlatch, Churn, Thompson, North Thompson, Gates, Cayoosh, Portage, Seton and Bridge River stocks; (2) Canada South Coast (Non-Fraser) – Quatse, Cluxewe, Wakeman, Adam, Kakweiken, Glendale, Klinaklini, Lull, Heydon, Big Qualicum, Keogh, Nanaimo, Quinsam, Puntledge, Ahta, Salmon, Oyster, Squamish and Indian river stocks; and (3) Washington – Nooksack, Skagit, Stillaguamish, Snohomish, Green, Puyallup, Hamma Hamma, Duckabush, Dosewallips, Dungeness, Hood Canal, and Nisqually river stocks. The stocks in this baseline represent most of the pink salmon production that could contribute to marine fishery catches where Fraser pink salmon are typically harvested.

During the 2017 in-season management period, tissue samples from up to 100 pink salmon were collected at approximately weekly intervals from particular fisheries. DNA analysis was similar to recent years with genotype data from 16 microsatellite loci being compared to 46 baseline stocks using the program ONCOR[29]. Stock composition estimates derived from these analyses were used primarily for assessing catch, migration route (diversion rate) and abundance of Fraser River pinks. DNA results were obtained for Canadian statistical Areas 12, 13 and 20 from test fishing catches (late July to early September), and for U.S. Areas 7 and 7A from commercial fishery samples (August to early September). The Area 13 test fishery was concluded on August 11, resulting in only two pink salmon sample days from that fishery. Estimated proportions of Fraser River pink salmon in these samples are presented in Figure G2. Fraser River pink salmon in both Johnstone Strait and the Strait of Juan de Fuca increased from about 20% in late July to approximately 70-85% by late-August. These results were not unusual relative to historical samples, despite the early and small return of pink salmon in 2017 (suggesting returns of non-Fraser pink salmon to these areas were also generally early and small).

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

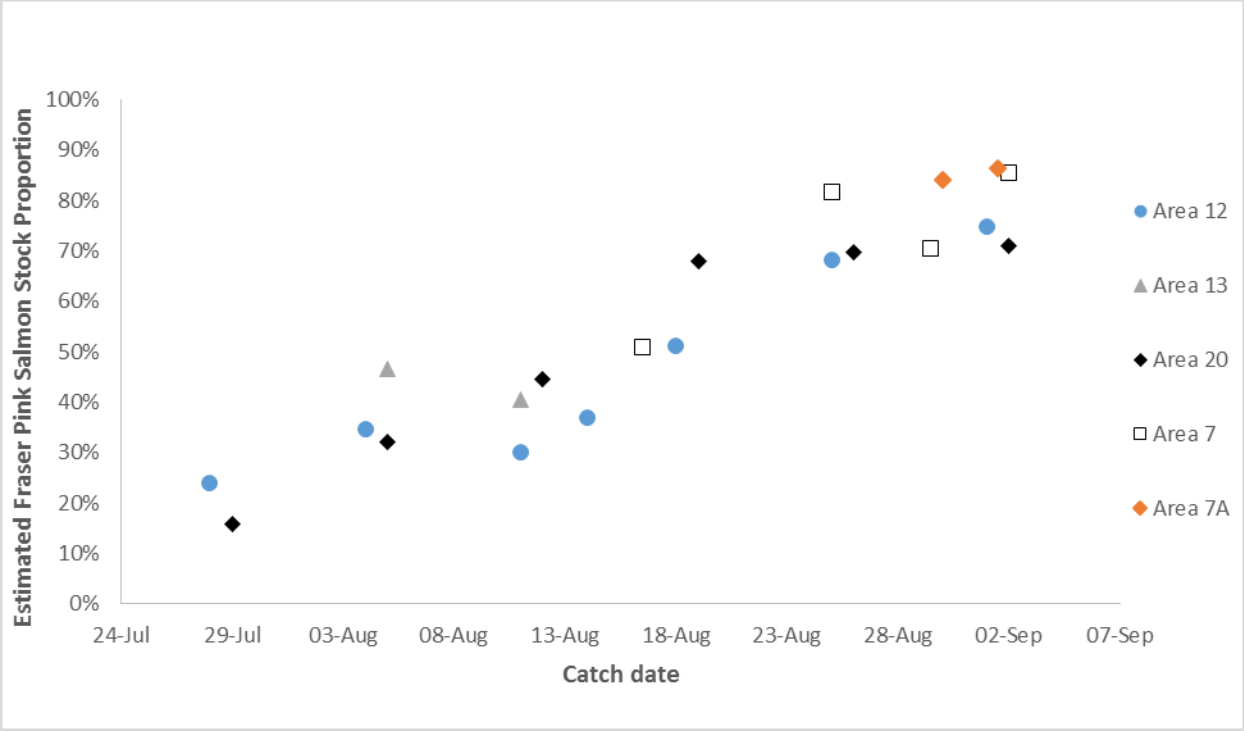

Figure G2. Percentages of Fraser River pink salmon in test fishery samples (from Areas 12, 13, and 20), and commercial fishery samples (Areas 7 and 7A). Dates are approximate catch dates unadjusted for migration.

Table G2 summarizes age composition (based on scale readings by PSC Staff) of caught sockeye compared to the pre-season forecast. The Early Stuart forecast for age four proportions was slightly higher than the frequency of age four fish sampled in-season. In-season Early Summer-run sockeye samples were predominantly age five fish with the exception of Gates, Bowron and Early South Thompson stocks, which were mostly age four fish. Pitt sockeye, the primary stock in 2017's Early Summer run, comprised a very high proportion of five-year-olds, resulting in only 30% four-year-olds overall for the management group. The Summer-run forecast included a large return of four-year-olds, particularly for Chilko. The prevalence of age four Chilko fish estimated in-season was lower than forecast. Harrison age four proportions were remarkably higher than forecasted, resulting in part from a very poor age three return compared to the forecast. The Late-run forecast included mainly age four fish and except for the relatively low frequency of age four individuals among Birkenhead sockeye identified in-season, age readings for the Late run were very similar to the age forecast.

Table G2. Summary of the 2017 forecast and in-season age composition estimates of sampled sockeye. 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	2017 Fraser Sockeye Forecasts			2017 In-season	
	FOUR YEAR OLDS p50[a]	TOTAL p50	FOUR YEAR OLD PROPORTION	Total Sampled	% Age -4
Earyl Stuart	**95,000**	**99,000**	**96%**	**126**	**90%**
Early Summer	**173,000**	**343,000**	**50%**	**660**	**30%**
Bowron	7000	7,000	100%	9	89%
Upper Barriere	12,000	14,000	88%	9	56%
Gates	44,000	49,000	90%	104	87%
Nadina	48,000	67,000	72%	21	43%
Pitt	11,000	84,000	13%	397	6%
Early S. Thompson	36,000	36,000	100%	46	98%
Taseko	500	500	100%	1	100%
Chilliwack	12,000	78,000	15%	57	11%
Nahatlatch	5,000	7,000	71%	16	44%
Summer	**3,006,000**	**3,408,000**	**88%**	**3968**	**95%**
Chilko	2,121,000	2,142,000	99%	1918	95%
Quesnel	192,000	192,000	100%	503	99%
Late Stuart/Stellako	565,000	730,000	77%	1153	95%
Harrison	40,000 (age-4)	251,000	16% (age-4)	249	98%
Raft / N. Thompson	84,000	88,000	95%	144	83%
Widgeon	4,000	5,000	80%	1	0%
Late	**537,000**	**583,000**	**92%**	**739**	**92%**
Cultus	3,000	3,000	98%	10	100%
Late Shuswap/ Portage	225,000	225,000	100%	139	99%
Weaver	180,000	186,000	97%	464	97%
Birkenhead	133,000	143,000	93%	95	63%
Misc Lillooet-Harrison	22,000	26,000	85%	31	77%
Total	**3,837,000**	**4,433,000**	**87%**	**5493**	**87%**

a. Probability that actual return will be at or below specified run size

Stock Assessment

Assessment of Fraser River sockeye abundance by stock group is primarily based on catch, effort, escapement and stock composition data. Since commercial catches were limited in 2017, stock assessment methods to estimate run size relied mainly on catch and catch per unit effort (CPUE) data from test fishing vessels in addition to reconstructed marine daily abundance estimates derived from in-river hydro-acoustic data. The CPUE data was converted into daily abundance estimates using a catchability estimate derived using a hierarchical analysis of historical data (Area 12 purse seine catchability: 5.6×10^{-3}, Area 20 purse seine catchability: 2.5×10^{-3}). The marine abundance estimates derived from in-river hydro-acoustic data and marine test fishery data were analysed using Bayesian stock assessment models[30, 31]. These models compare the reconstructed daily migration pattern to ideal run-timing curves, assuming the run is normally distributed. By assuming the run follows this idealized pattern, the run size can be estimated once the 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) has been identified, by doubling the abundance up to that date. Prior to observing the peak of the run, there is considerable uncertainty

[30] Pacific Salmon Commission. 1995. Pacific Salmon Commission run-size estimation procedures: An analysis of the 1994 shortfall in escapement of Late-run Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 6: 179 p.

[31] Pacific Salmon Commission. 1998. Report of the Fraser River Panel to the Pacific Salmon Commission on the 1995 Fraser River sockeye and pink salmon fishing season. Vancouver, B.C., 64 p.

about the run size. Based on initial observations before the peak of the run, the estimates can indicate the run to be earlier and smaller than forecast, or later and larger than forecast.

The uncertainty about the actual size of the run is estimated using Bayesian methodology. The Bayesian version of the cumulative normal model relies on additional information (pre-season forecasts of run size based on historic stock-recruit data and timing based on sea-surface temperature (SST) and eastward current speed index in the Gulf of Alaska, expected duration of the run, average historical expansion line estimates and pre-season forecasts of diversion rate based on SST) to reduce the uncertainty and keep the run size estimates within realistic bounds. This prior information is incorporated within the Bayesian model through the use of prior probability distributions (priors). These priors indicate a range of values that are assumed plausible for the various model parameters and depending on the shape of the prior probability distribution indicate which parameter values are assumed more plausible than others. Theoretically the Bayesian version of the cumulative normal model should provide more stable estimates since it relies on both in-season data as well as historical data. Retrospective analyses have confirmed that incorporating prior knowledge is especially advantageous before the 50% migration date is known. Bayesian stock assessment models are especially useful around the 50% migration date of the run as well as immediately after. After this period, when the run size will depend on the remainder of the run still to come, the run size can be estimated by adding the Bayesian estimate of the tail of the normal distribution to the accounted run-to-date.

Because the results from the traditional in-season run size assessment model for Fraser River pink salmon were ambiguous in 2017 (indicating earlier and smaller run size than ever observed), an alternative methodology was applied. On August 28 (average historical 50% migration date for Fraser River pink salmon), the in-season run size estimate was based on the relationship between the total CPUE from August 24 to August 27 and the total run size (excluding years with total CPUE > 10,000). Using nine years of data, this model explained 67% of the historical variance in run size. On September 8, the in-season run size was updated further by doubling the total reconstructed pink salmon abundance up to the 50% migration date obtained by the traditional run size assessment model.

Figures G3 a, b, c, d and e provide an overview of the run size estimates from the stock assessment model and the accounted run size at various dates during the season (median and 80% probability interval). 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 2017, pre-season forecasts overestimated the run size for all management groups but especially Summer-run sockeye and pink salmon. The timing of the sockeye run was later than expected for all sockeye management groups and substantially earlier than expected for Fraser River pink salmon.

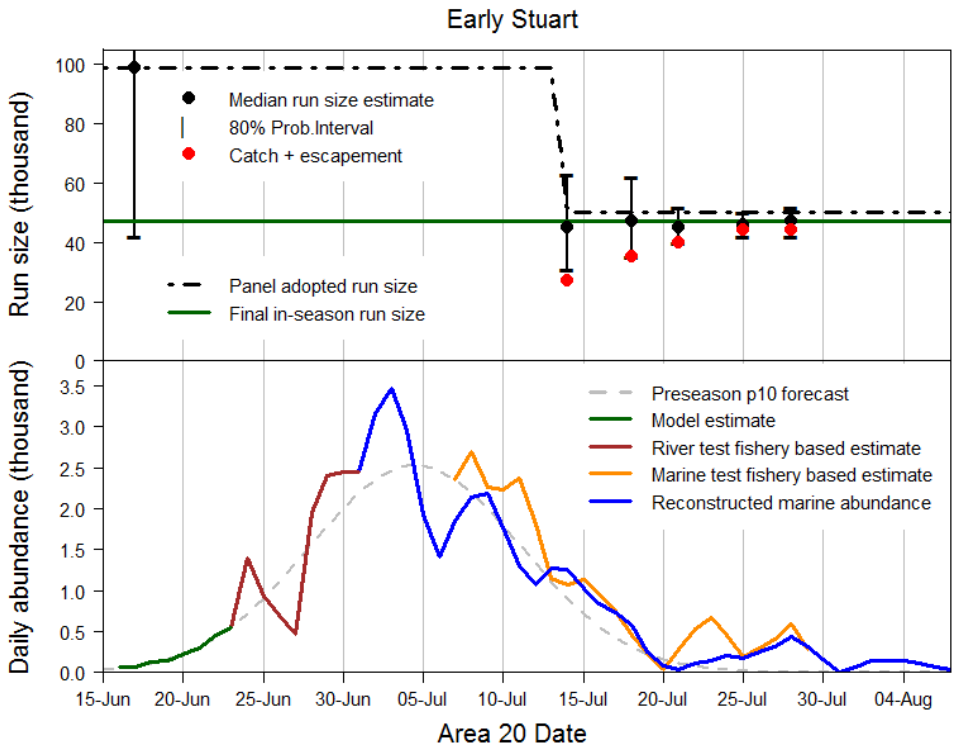

Figure G 3a: Daily reconstructed abundance estimates for Early Stuart and corresponding run size estimates at different times during the season.

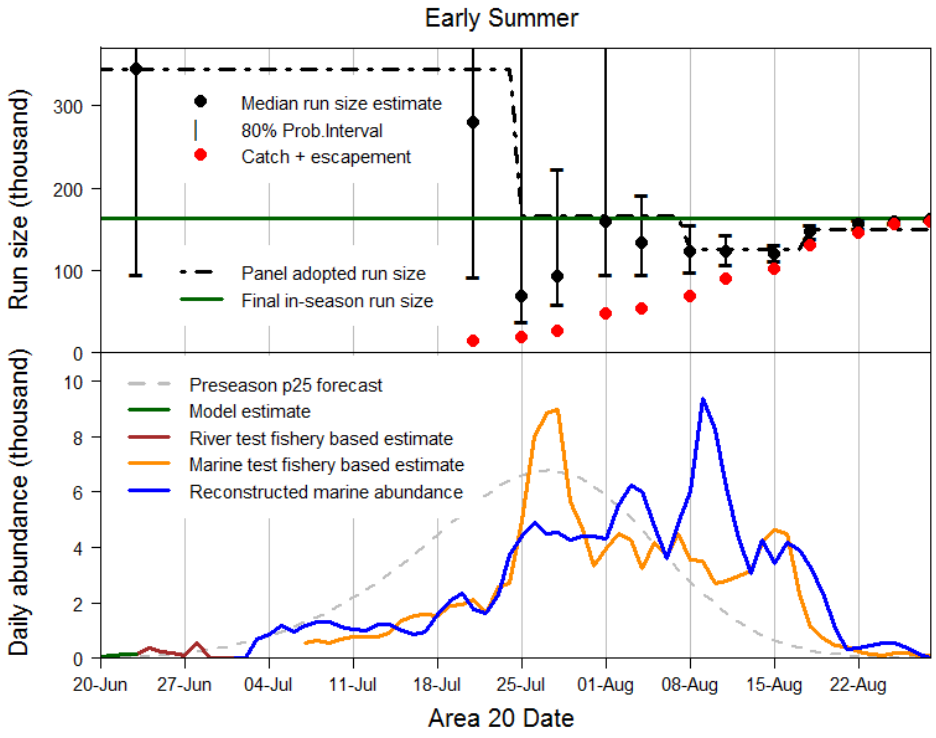

Figure G3b: Daily reconstructed abundance estimates for Early Summer-run salmon and corresponding run size estimates at different times during the season.

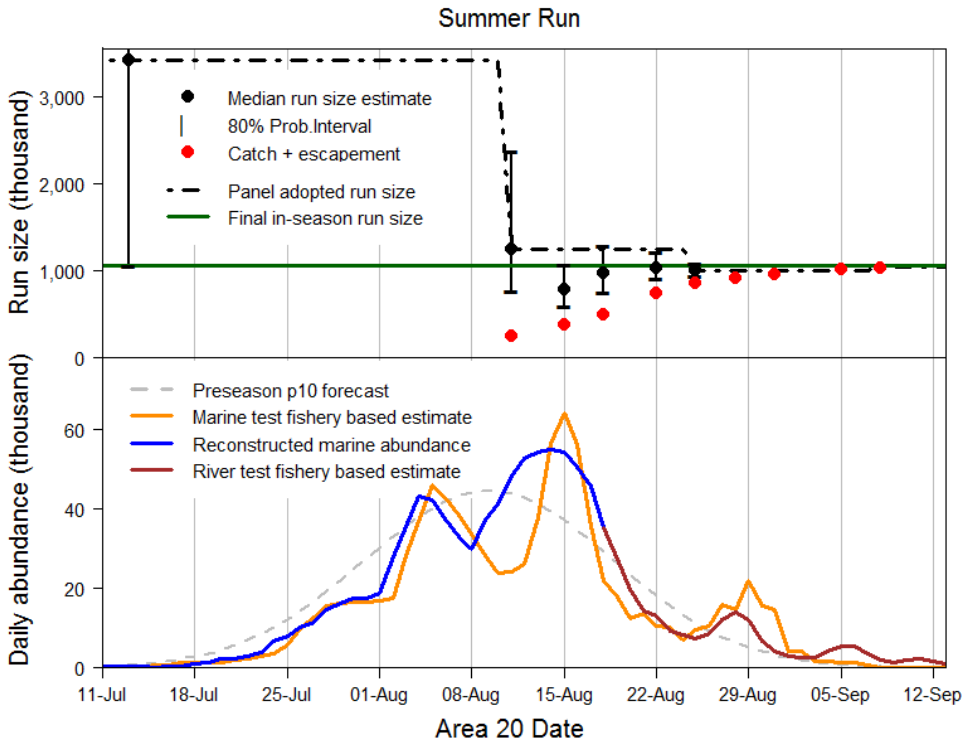

Figure G3c: Daily reconstructed abundance estimates for Summer-run salmon and corresponding run size estimates at different times during the season.

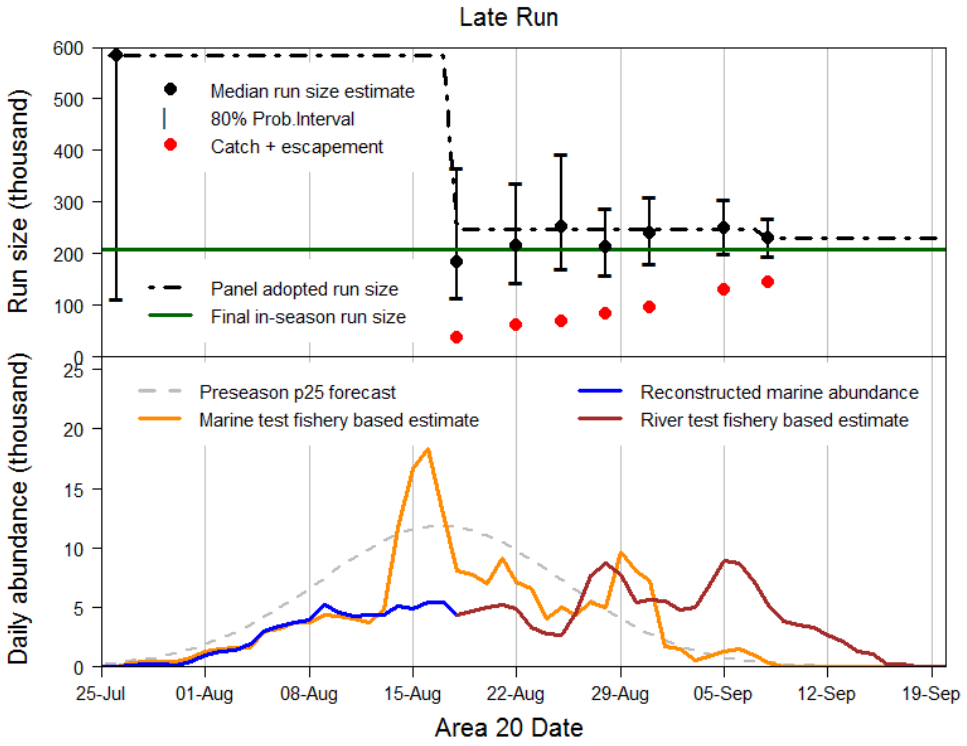

Figure G3d: Daily reconstructed abundance estimates for Late-run salmon and corresponding run size estimates at different times during the season.

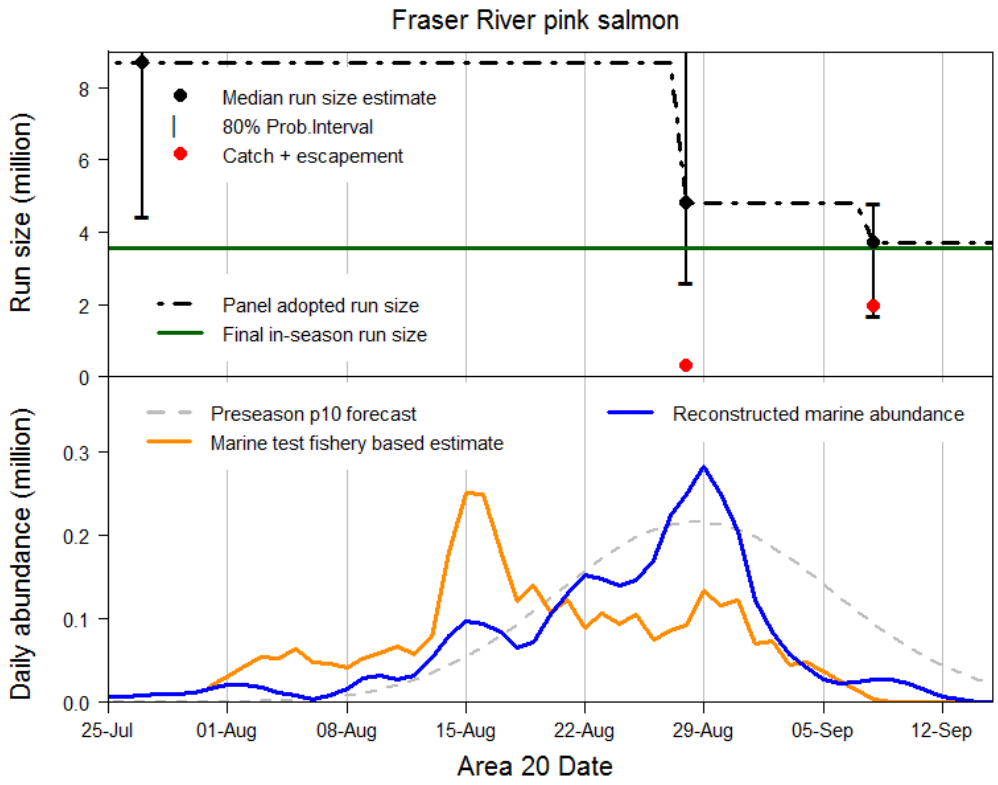

Figure G3e: Daily reconstructed abundance estimates for Fraser River pink salmon and corresponding run size estimates at different times during the season.

Management Adjustment and DBE

For pre-season planning, the Environmental Watch program at Fisheries and Oceans Canada presented a long-range forecast of Fraser River environmental conditions that projected average flow conditions in the river. Long-range air temperature forecasts projected above average summer air temperatures; however, water temperatures were to have some buffering from normal flow levels. Staff used the environmental forecasts in Management Adjustment (MA) models developed jointly by DFO and the PSC to predict how many additional Early Stuart, Early Summer and Summer-run sockeye should be allowed to escape to increase the probability of achieving spawning escapement objectives (see references in the Management Adjustment section of the Management Information section). The Panel adopted the proportional Management Adjustments (pMAs) forecast from the environmental MA models based on timing estimates used for April pre-season planning minus four days, for the non-Pitt and non-Chilliwack Early Summer run and the non-Harrison Summer-run groups (Table G4).

Table G3. Summary of the MA model predictions and adopted values for the different components used pre-season and in-season to generate the pMA for Early Stuart, Early Summer, Summer and Late-run Management groups.

Description	Early Stuart[1,2]		Early Summer (excld. Pitt and Chw.)[2,3]		Pitt[2,5]		Chilliwack[2,5]		Summer (excld. Harrison)[2,3]		Harrison[2,5]		Lates (excld. Birk.)[2,4]		Birkenhead[2,5]	
	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA
Pre-season Adopted	NA	NA	-27%	0.37	-15%	0.18	-43%	0.74	-4%	0.04	-29%	0.40	-57%	1.32	-25%	0.34
In-season 19-day MA Model Predictions	-45%	0.82	-52%	1.09	NA	NA	NA	NA	-25%	0.34	NA	NA	NA	NA	NA	NA
In-season 31-day MA Model Predictions	-32%	0.48	-52%	1.07	NA	NA	NA	NA	-28%	0.39	NA	NA	NA	NA	NA	NA
In-season run-timing Model Predictions	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-68%	2.08	NA	NA

1 Given the 2017 pre-season forecasts of abundances, fisheries decisions that could impact the Early Stuart management group were based on Low Abundances Exploitation (LAER) limits of 10%.

2 The pMAs adopted preseason for these stocks remained fixed in-season.

3 MAs are estimated by 19-day and 31-day temperature and discharge models.

4 MAs are estimated by the run timing model using their Mission 50% date.

5 MAs for these groups are based on medians calculated from subset of the historical date as indicated in Table G4.

Given the 2017 forecast of abundances for Early Stuart, fisheries decisions that could impact Early Stuart sockeye were based on Low Abundance Exploitation Rate (LAER) limits of 10%. For pre-season planning purposes, the Panel did not adopt a proportional Management Adjustment (pMA) for Early Stuart. However, the Panel did adopt pre-season pMAs for the Early Summer, Summer and Late-run aggregates pre-season (Table 5). These pMAs were derived from the weighted average %DBE which is estimated from pre-season MA models and historical median %DBEs and the median pre-season forecast of abundances for relevant component groups. The Early Summer-run had three components consisting of Chilliwack, Pitt and the remaining Early Summer-run stocks (see Table G3 for individual pDBEs and Table G4 for individual pre-season predictor variables). The Panel adopted a pre-season pMA of 0.39 for the Early Summer run aggregate. The Summer-run had two components consisting of Harrison and non-Harrison stocks (see Table G3 for individual %DBEs and Table G4 for individual pre-season predictor variables). The Panel adopted a pre-season pMA of 0.06 for the Summer-run aggregate. The Late-run aggregate was divided into Birkenhead and non-Birkenhead components (see Table G3 for individual %DBEs and Table G4 for individual pre-season predictor variables). The Panel adopted a pre-season pMA of 0.92 for the Late-run aggregate.

Table G4. Summary of the pre-season and in-season MA models and assumptions used during 2017 for each management group. In-season timing refers to the final updated date for each group. Details regarding assumptions for pre-season timing can be found in the Pre-season Planning section of the report in the Panel Management Activities section.

Management Group	Pre-season Predictor Variables	In-season Predictor Variables	Cycle lines Used	Excluded Years
Early Stuart	31-day temp and discharge [2]	19-day temp and discharge [1]	All	1977, 1980, 1982, 1984, 1986, 2006, 2015, 2016
Early Summer w/o Chilliwack and Pitt	31-day temp and discharge [2]	19-day temp and discharge [1]	All	1993, 2006
Chilliwack	Historical Dom/Subdom Cycle Median for 2004-2016	Historical Dom/Subdom Cycle Median for 2004-2016	2016 & 2017	years with DNA n<30 fish identified as Chilliwack
Pitt	Historical Median for all years until 2012, using inseason data for 1998, 2000-2004	Historical Median for all years until 2012, using inseason data for 1998, 2000-2004	All	1982, 1983, 1999, 2005, 2006
Summer w/o Harrison	31-day temp and discharge [2]	19-day temp and discharge [1]	All	2002, 2006
Harrison	Historical Median 2004-2016	Historical Median 2004-2016	All	pre 2004, 2006
Birkenhead	Median of all years	Median of all years	All	1979, 2002, 2006
Lates w/o Birkenhead	Historical Odd Year Cycle Line Median since 1996	Historical Odd Year Cycle Line Median since 1996 if timing Sept 8th or earlier, All Years Run Timing Model [3] if timing is Sept 9th or later	2015 & 2017 if timing Sept 8th or earlier, All if timng is Sept 9th or later	2006 and All years model also excludes, 1977, 1979, 1980, 1981, 1983, 1984, 1985, 1987, 1988, 1989, 1991, 1992, 1993, 1995

[1] $\ln(DBE) = a + b_1T + b_2T^2 + b_3Q + b_4Q^2$ where T = 19-day (3-days before and 15-days after the Hells Gate 50% date) temperature and Q = 19-day (3-days before and 15-days after the Hells Gate 50% date) discharge.

[2] $\ln(DBE) = a + b_1T + b_2T^2 + b_3Q + b_4Q^2$ where T = 31-day (15-days before and 15-days after the Hells Gate 50% date) temperature and Q = 31-day (15-days before and 15-days after the Hells Gate 50% date) discharge.

[3] $\ln(DBE) = a + bR$ where R is Mission timinig

In-season, reductions to run size resulted in the Summer and Late run being managed under a low abundance exploitation rate (LAER). MAs were not a relevant factor in determining management actions for these run timing groups. Predictions from in-season environmental MA models of estimates of %DBEs (Table G3) were presented to the Panel for the Early Summer and Summer run. For Late run, a prediction of the %DBE estimate was presented from the run-timing MA model based on their 50% date at Mission. The spawning escapement targets for Early Stuart, Summer and Late run were their entire run size at in-season adopted run size levels. The Early Summer run spawning escapement target (137,000 sockeye) was just below its entire run size at in-season adopted run size levels (165,000 sockeye). These targets coupled with the application of a LAER and the likelihood of some difference between estimates (DBEs) meant that spawning escapement targets were unlikely to be reached in 2017.

Spawning ground estimates of Fraser sockeye abundance totalled 941,100 sockeye, which means a total %DBE of (-34%) was observed in 2017. The magnitude of the DBE likely contributed to all four run timing groups not achieving their spawning escapement targets.

See Table G4 for a detailed summary of the Management Adjustment approaches by stock group.

APPENDIX H: HISTORICAL CATCH, ESCAPEMENT AND PRODUCTION DATA

Table H1. Catch by user group, spawning escapement, difference between estimates and run size of Fraser River sockeye salmon for cycle years 2005-2017.

	Fraser Sockeye Salmon			
	2005	**2009**	**2013**	**2017**
CANADIAN CATCH	**1,142,600**	**73,800**	**411,300**	**71,900**
Commercial Catch	**129,400**	**0**	**2,100**	**0**
Panel Area	3,400	0	1,200	0
Non-Panel Areas	126,000	0	900	0
First Nations Catch	**956,200**	**71,800**	**407,400**	**71,700**
Marine FSC	266,600	9,900	122,900	9,400
Fraser River FSC	684,200	61,900	284,400	62,300
Economic Opportunity	5,500	0	100	0
Non-commercial Catch	**57,000**	**2,000**	**1,800**	**100**
Marine Recreational	7,000	0	0	0
Fraser Recreational	42,600	0	0	0
Charter (Albion)	700	2,000	700	100
ESSR	6,600	0	1,200	0
UNITED STATES CATCH	**525,700**	**17,200**	**66,600**	**1,500**
Washington Total	**231,500**	**4,300**	**20,200**	**1,500**
Commercial catch	**230,500**	**0**	**4,300**	**0**
Treaty Indian	160,100	0	4,100	0
Non-Indian	70,400	0	200	0
Non-commercial Catch	**1,000**	**4,300**	**15,900**	**1,500**
Ceremonial	1,000	4,300	15,900	1,500
Recreational	0	0	0	0
Alaska*	**294,300**	**12,900**	**46,400**	**NA**
TEST FISHING CATCH	**117,500**	**32,100**	**99,700**	**13,800**
PSC (Panel Areas)	**48,000**	**20,400**	**36,600**	**7,400**
Canada	42,200	16,900	29,600	7,400
United States	5,800	3,500	7,000	0
Canada (non-Panel Areas)	**69,500**	**11,700**	**63,100**	**6,500**
TOTAL RUN	**7,107,700**	**1,637,400**	**4,279,000**	**1,471,200**
Total Catch in All Fisheries	1,785,900	123,200	577,600	87,200
Adult Spawning Escapement	3,308,000	1,055,700	2,479,500	940,100
Jack Spawning Escapement	52,800	47,900	92,800	15,800
Difference between estimates	1,961,000	410,600	1,129,100	428,100
Percentage of Total Run	**100%**	**100%**	**100%**	**100%**
Total Catch in All Fisheries	25%	8%	13%	6%
Adult Spawning Escapement	47%	64%	58%	64%
Jack Spawning Escapement	1%	3%	2%	1%
Difference between estimates	28%	25%	26%	29%

* The preliminary 2017 Alaska catch of Fraser sockeye in D104 is estimated to be 18,700

Table H2. Catch by user group, spawning escapement and run size of Fraser River pink salmon for cycle years 2011-2017.

	Fraser Pink Salmon			
	2011	**2013**	**2015**	**2017**
CANADIAN CATCH	**4,931,000**	**3,313,700**	**83,300**	**37,200**
Commercial Catch	**3,757,200**	**1,994,300**	**0**	**0**
Panel Area	797,700	1,322,500	0	0
Non-Panel Areas	2,959,500	671,800	0	0
First Nations Catch	**1,050,300**	**1,220,700**	**68,000**	**33,600**
Marine FSC	21,600	2,900	3,400	14,800
Fraser River FSC	37,400	8,200	25,200	18,900
Economic Opportunity	991,300	1,209,600	39,400	0
Non-commercial Catch	**123,600**	**98,700**	**15,300**	**3,500**
Marine Recreational	63,200	30,200	0	0
Fraser Recreational	55,300	63,800	15,300	0
Charter	1,200	200	0	3,500
ESSR	3,800	4,500	0	0
UNITED STATES CATCH	**2,916,500**	**3,200,400**	**330,900**	**102,200**
Washington Total	**2,916,500**	**3,200,400**	**330,900**	**102,200**
Commercial catch	**2,901,500**	**3,186,700**	**328,000**	**102,200**
Treaty Indian	1,403,800	1,340,600	183,700	91,300
Non-Indian	1,497,700	1,846,100	144,300	10,900
Non-commercial Catch	**15,000**	**13,700**	**2,800**	**0**
Ceremonial	13,800	5,900	2,800	0
Recreational	1,200	7,800	0	0
Alaska	**0**	**0**	**0**	**0**
TEST FISHING CATCH	**13,100**	**39,200**	**48,900**	**17,700**
PSC (Panel Areas)	**11,900**	**22,000**	**38,100**	**13,700**
Canada	9,300	15,500	25,400	11,800
United States	2,600	6,600	12,700	1,800
Canada (non-Panel Areas)	**1,200**	**17,200**	**10,800**	**4,000**
TOTAL RUN	**20,649,000**	**15,897,800**	**5,778,900**	**3,549,200**
Total Catch in All Fisheries	7,860,600	6,553,300	463,100	157,100
Adult Spawning Escapement	12,788,400	9,344,500	5,315,800	3,392,200
Percentage of Total Run	**100%**	**100%**	**100%**	**100%**
Total Catch in All Fisheries	38%	41%	8%	4%
Adult Spawning Escapement	62%	59%	92%	96%

Table H3. Escapements of sockeye salmon to Fraser River spawning areas for cycle years 2005-2017*

DISTRICT / Stock Group / Stream/Lake	Year 2005	2009	2013	2017
NORTHEAST				
Upper Bowron R.	1,730	2,170	3,268	244
STUART				
Early Stuart				
Driftwood R.	15,911	8,292	23,875	1,342
Takla L. Streams	41,887	16,513	27,011	3,819
Middle R. Streams	23,201	9,877	18,441	7,213
Trembleur L. Streams	15,841	10,580	16,258	3,044
Miscellaneous	1,697	35	677	5
Late Stuart				
Kazchek Cr.	1,557	1,271	1,800	332
Kuzkwa Cr.	13,681	4,109	5,282	6,639
Middle R.	72,228	28,831	24,293	22,538
Tachie R.	185,879	47,415	96,385	114,226
Miscellaneous	19,779	5,338	4,004	3,240
NECHAKO				
Nadina R. (Late)	9,049	7,008	4,973	2,053
Nadina Channel	12,785	4,392	8,247	2,938
Stellako R.	175,299	27,541	97,757	90,998
QUESNEL				
Horsefly R.	657,844	62,627	70,659	71,598
Horsefly Channel	0	8,162	8,670	0
McKinley Cr.	142,200	11,527	14,510	6,831
Mitchell R.	553,111	46,065	62,127	23,605
Miscellaneous	94,226	21,019	25,740	12,130
CHILCOTIN				
Chilko R. & L.	535,967	213,379	1,197,733	369,573
Chilko Channel	0	0	0	0
Taseko L.	520	40	201	20
SETON-ANDERSON				
Gates Cr.	2,020	4,688	42,357	4,495
Gates Channel	13,130	5,190	12,582	2,442
Portage Cr.	12,082	1,773	7,327	1,198
NORTH THOMPSON				
North Thompson R.	77,700	4,957	21,498	7,155
Raft R.	26,456	11,504	16,368	4,516
Upper Barriere	4,304	1,170	3,471	667
SOUTH THOMPSON				
Early Summer-run				
Scotch Cr.	4,163	4,672	23,867	4,975
Seymour R.	3,590	5,164	22,594	3,223
Upper Adams R.	330	268	538	47
Miscellaneous	1,348	2,363	10,191	1,646
Late-run				
Adams R.	12,423	16,057	114,194	14,626
Little R.	7,916	14,491	30,892	267
Lower Shuswap R.	382	598	2,445	117
Miscellaneous	392	1,335	5,450	59
HARRISON-LILLOOET				
Birkenhead R.	53,546	53,977	80,085	18,627
Big Silver Cr. + Birk. types	5,315	7,620	8,742	7,013
Harrison R.	388,605	307,210	250,087	49,983
Weaver Cr.	12,948	8,442	8,099	6,956
Weaver Channel	35,568	27,114	27,438	25,822 [1]
LOWER FRASER				
Nahatlatch R. & L.	2,168	1,439	2,099	1,923
Cultus L.	193 [1]	987 [1]	2,306 [1]	784 [1]
Upper Pitt R.	62,047	31,034	59,247	34,159
Chilliwack L./Chilliwack R., upper	3,407	5,587	11,705	6,746
MISCELLANEOUS [2]	3,525	1,980	3,974	297
ADULTS	3,307,950	1,055,811	2,479,467	940,131
JACKS	52,763	47,792	92,840	15,768
TOTAL NET ESCAPEMENT	3,360,713	1,103,603	2,572,307	955,899

* Estimates are from DFO.

1 Cultus estimates include 81 adults + 68 jacks in 2005, 282 adults in 2009, 200 adults in 2013, 111 adults in 2017.

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

Table H4. Fraser River pink salmon production for odd brood years in 1961-2015 (return years 1963-2017).

Brood Year (by)	Spawners Total (millions) (by)	Spawners Female (millions) (by)	Potential Egg Deposition (millions) (by)		Fry Production (millions) (by+1)	Adult Returns (Catch + Escapement) (millions) (by+2)		% Survival Fresh Water	% Survival Marine	Average To Date
1961	1.092	0.654	1,569		143.6	5.482		9.2%	3.8%	3.8%
1963	1.954	1.216	2,435		284.2	2.320		11.7%	0.8%	2.3%
1965	1.194	0.692	1,488		274.0	12.963		18.4%	4.7%	3.1%
1967	1.831	0.973	2,132		308.0	3.931		14.4%	1.3%	2.7%
1969	1.531	0.957	2,018		287.7	9.763		14.3%	3.4%	2.8%
1971	1.805	1.096	1,923		273.6	6.801		14.2%	2.5%	2.8%
1973	1.754	1.009	1,865		212.3	4.894		11.4%	2.3%	2.7%
1975	1.367	0.781	1,493		319.7	8.209		21.4%	2.6%	2.7%
1977	2.388	1.362	2,960		483.7	14.404		16.3%	3.0%	2.7%
1979	3.561	2.076	3,787		341.3	18.685		9.0%	5.5%	3.0%
1981	4.488	2.560	4,814		607.0	15.346		12.6%	2.5%	2.9%
1983	4.632	2.931	4,702		557.4	19.038		11.9%	3.4%	3.0%
1985	6.461	3.561	5,900		264.5	7.172		4.5%	2.7%	3.0%
1987	3.224	1.856	3,471		436.0	16.484		12.6%	3.8%	3.0%
1989	7.189	4.383	7,198		400.4	22.174		5.6%	5.5%	3.2%
1991	12.943	8.002	12,330		685.5	16.983		5.6%	2.5%	3.1%
1993	10.768	6.454	9,192		437.7	12.904		4.8%	2.9%	3.1%
1995	7.175	4.248	10,233		279.1	8.176		2.7%	2.9%	3.1%
1997	2.842	1.740	2,863		257.5	3.608		9.0%	1.4%	3.0%
1999	3.445	1.885	2,702		219.0	21.262		8.1%	9.7%	3.4%
2001	19.814	9.543	16,274		714.4	24.250		4.4%	3.4%	3.4%
2003	n/a	n/a	n/a	*1*	419.0	9.870	*2*	n/a	2.4%	3.3%
2005	n/a	n/a	n/a	*1*	614.5	8.490	*2*	n/a	1.4%	3.2%
2007	n/a	n/a	n/a	*1*	497.0	19.936	*2*	n/a	4.0%	3.3%
2009	15.429	n/a	n/a	*1*	1062.4	20.649	*3*	n/a	1.9%	3.2%
2011	12.788	n/a	n/a	*1*	519.3	15.898	*3*	n/a	3.1%	3.2%
2013	9.344	n/a	n/a	*1*	609.4	5.779	*3*	n/a	0.9%	3.1%
2015	5.369	n/a	n/a	*1*	230.0	3.550	*3*	n/a	1.5%	3.1%
Average	5.776	2.761	4,826		419.2	12.108		10.6%	3.1%	

1 No on the grounds surveys

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

3 Estimates of escapements for the 2009 - 2017 return years are from the PSC's Mission hydroacoustics program.

Table H5. Detailed calculation of total allowable catch (TAC) and achievement of international catch shares for Fraser sockeye (by management group) salmon in 2017. Calculations are based on the in-season estimates of abundance, spawning escapement target and Management Adjustment at the time the Panel relinquished control of the last U.S Panel Area (October 7), in accordance with Annex IV, Chapter 4 of the Pacific Salmon Treaty.

	Fraser Sockeye						Fraser Pinks	
	Early Stuart	Early Summer	Summer	Late	Total			
RUN STATUS, ESCAPEMENT NEEDS & AVAILABLE SURPLUS								
In-season Abundance Estimate	**47,000**	**165,000**	**1,044,000**	**231,000**	**1,487,000**		**3,700,000**	
Adjusted Spawning Escapement Target *	**47,000**	**165,000**	**1,044,000**	**231,000**	**1,487,000**		**3,409,100**	
Spawning Escapement Target (SET)	47,000	137,000	1,044,000	231,000	1,459,000		3,409,100	
%SET from TAM rules	*100%*	*83%*	*100%*	*100%*			1	
Management Adjustment (MA)	NA	53,400	62,600	212,500	328,600		n/a	
Proportional MA (pMA)	*NA*	*0.39*	*0.06*	*0.92*				
Test Fishing Catch (TF, post-seas. est.)	300	1,400	10,200	1,900	13,800		17,700	
Surplus above Adjusted SET & TF *	**0**	**0**	**0**	**0**	**0**		**273,200**	
DEDUCTIONS & TAC FOR INTERNATIONAL SHARING								
Aboriginal Fishery Exemption (AFE)	**2,600**	**1,900**	**62,600**	**4,600**	**71,700**		**n/a**	
Total Deductions (Adj.SET + TF + AFE)	50,000	168,300	1,116,700	237,500	1,572,600		3,426,800	
Available TAC (Abundance - Deductions)	**0**	**0**	**0**	**0**	**0**		**273,200**	
UNITED STATES (Washington) TAC								
Propor. distrib. TAC - Payback	**0**	**0**	**-500**	**-400**	**-900**		**70,200**	
Proportionally distributed TAC **	0	0	0	0	0	16.5%	70,200	25.7%
U.S. Payback	0	0	-500	-400	-900		0	
Washington Catch	0	0	900	600	1,500		102,200	
Deviation from TAC - Payback	**0**	**0**	**-1,400**	**-1,000**	**-2,400**		**-32,000**	
CANADIAN TAC								
Propor. distrib. TAC + Payback + AFE	**2,600**	**1,900**	**63,100**	**333,300**	**72,600**		**203,000**	
Propor. distrib. TAC + U.S. Payback	0	0	500	400	900	83.5%	203,000	74.3%
AFE	2,600	1,900	62,600	332,900	71,700		0	
Canadian Catch excluding ESSR Catch	2,600	1,900	62,700	4,600	71,900		37,200	
Deviation from TAC + Payback + AFE	**0**	**0**	**400**	**300**	**800**		**165,800**	
TOTAL								
Available TAC + U.S. Payback + AFE	**2,600**	**1,900**	**63,100**	**4,900**	**72,600**		**273,200**	
Total Catch excluding ESSR Catch	2,600	1,900	63,500	5,200	73,400		139,400	
Deviation from TAC + U.S. Payback + AFE	**0**	**0**	**-400**	**-300**	**-700**		**133,800**	

* The surplus cannot exceed the estimated abundance.

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

APPENDIX I: MEMBERS OF THE FRASER RIVER PANEL TECHNICAL COMMITTEE IN 2017

Canada	United States
J. Scroggie, Co-Chair *Fisheries and Oceans Canada*	R. Conrad, Co-Chair *Northwest Indian Fisheries Commission*
S. Grant *Fisheries and Oceans Canada*	M. Litz *Washington Department of Fish and Wildlife*
R. Goruk *Fisheries and Oceans Canada*	P. Mundy *National Marine Fisheries Service*
M. Hawkshaw *Fisheries and Oceans Canada*	
M. Staley *First Nations Advisor*	

APPENDIX J: STAFF OF THE PACIFIC SALMON COMMISSION IN 2017

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, Controller

Witty Lam, Senior Accountant

Koey Lu, Accounting Assistant

Angus Mackay, Manager, Restoration & Enhancement Funds

Victor Keong, Program Assistant, Restoration & Enhancement Funds

FISHERIES MANAGEMENT DIVISION STAFF

Mike Lapointe, Chief Biologist

Stock Assessment Group

Catherine Michielsens, Director, Modelling and Data Management

Merran Hague, Quantitative Fisheries Biologist

Kent Collens, Database Manager

Stock Identification Group

Fiona Martens, Director, Coordination and Stock Identification

Maxine Forrest, Manager, Scale Lab

Steve Latham, Manager, Stock Identification

Julie Sellars, Senior Scale Analyst

Catherine Ball, Scale Lab Technician

Pasan Samarasin, Stock Identification Biologist

Miki Shimomura, Salmon Data Technician

Stock Monitoring Group

Erica Jenkins, Director of Stock Monitoring

Keith Forrest, Manager, Test Fishing Operations

Yunbo Xie, Hydroacoustic Scientist

Cory Lagasse, Manager, Hydroacoustic Operations

Jacqueline Nelitz, Hydroacoustic Technician

Mike Bartel Sawatzky, Hydroacoustic Technician