
**Report of the
Fraser River Panel
to the
Pacific Salmon Commission
on the
2011 Fraser River Sockeye and
Pink Salmon Fishing Season**



Prepared by the

**Pacific Salmon Commission
January 2016**

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**REPORT OF THE
FRASER RIVER PANEL
TO THE PACIFIC SALMON COMMISSION
ON THE 2011 FRASER RIVER SOCKEYE AND PINK
SALMON FISHING SEASON**

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January 2016

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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 3,177,000 Fraser River sockeye salmon based on an assumption that productivity had remained similar to recent years, and 17,495,000 Fraser River pink salmon.
2. Pre-season expectations of migration parameters included a 32% diversion rate for Fraser River sockeye through Johnstone Strait and a 59% diversion rate for Fraser River pink salmon. Expected Area 20 50% migration dates were June 29 for Early Stuart, July 31 for Early Summer, August 7 for Summer, August 11 for Late-run sockeye and August 25 for pink salmon.
3. Pre-season spawning escapement goals were 17,000 Early Stuart, 181,000 Early Summer, 600,000 Summer and 483,000 Late-run (including Harrison and Birkenhead) sockeye for a total of 1,281,000 sockeye spawners and 6,000,000 pink spawners (Table 1). The goals for each sockeye management group were established by applying Canada's Spawning Escapement Plan (Appendix B) to the forecasted run size.
4. Management Adjustments (MAs) of about 21,000 Early Stuart fish and 38,000 Early Summer fish were added to the spawning escapement targets to increase the likelihood of achieving the targets. These MAs were based on relationships between river conditions (discharge and temperature) and historical differences between lower and upriver escapement estimates.
5. For Late-run sockeye, the Panel assumed a continuation of the early upstream migration behaviour and associated high mortality that has occurred since 1996. The Panel adopted a pMA of 0.69 (equivalent to an MA of 333,000 sockeye) for pre-season planning, based on the median of the three most recent years of the current cycle line (i.e., 1999, 2003, 2007). In 2003 (the year with the median pMA), the upstream timing of the Late-run migration at Mission was August 27.
6. The projected Total Allowable Catch (TAC) of Fraser River sockeye salmon based on the median forecasted abundances and agreed deductions was 1,095,000 sockeye (Table 1), of which 16.5% (180,600 sockeye) were allocated to the United States (U.S.). The projected TAC for pink salmon was 11,485,000 fish, of which 25.7% (2,952,000 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. The model runs also indicated that the pink TAC was unlikely to be achieved by either country due to fisheries constraints required to achieve Late-run sockeye salmon escapement targets.
8. The Panel adopted the Management Plan Principles and Constraints, Guidelines to Address Late-run Concerns and the 2011 Regulations (Appendices D, E and F).

In-season Management Considerations

9. Marine migration timing (Figure 3) was a few days (3-5 days) later than pre-season expectations for all sockeye management groups except Harrison, which was as expected. The migration of Fraser pink salmon was 2 days later than expected (Figure 4).
10. The overall Johnstone Strait diversion rate was 62% for sockeye and 44% for pink salmon, compared to pre-season forecasts of 32% and 59%, respectively (Figure 5).
11. Returns of both sockeye and pink salmon exceeded the median pre-season forecasts. Harrison sockeye demonstrated the most substantial deviation, with a return abundance (1,393,000 fish) that was almost 4 times the median pre-season forecast (372,000 fish).
12. Fraser River discharge remained well above the historical average for the duration of the season while river temperatures remained below average until late August (Figure 6). As a result of the higher than expected discharge levels, pre-season pMA values for Early Stuart and Early Summer groups were replaced in-season with higher values. An in-season Late-run MA approach was adopted in August that involved a separate, fixed pMA for Harrison and the use of an MA prediction model for non-Harrison Late-run stocks based on migration

timing. The in-season pMA for the non-Harrison Late run decreased from the pre-season value because its upstream migration timing was later than expected.

Run Size, Catch and Escapement

13. Returns of adult Fraser sockeye totalled 5,124,000 fish (Tables 8 and 9), about three times the brood year abundance of 1,510,000 fish in 2007. Divided into management groups, adult returns totalled 21,000 Early Stuart, 564,000 Early Summer, 2,023,000 Summer, 1,393,000 Harrison and 1,123,000 Late-run sockeye. This return of Early Stuart sockeye was very poor in a historical context, in contrast to the return of Harrison sockeye which was very good. Returns of the remaining management groups were similar in magnitude to recent cycle years.
14. Catches of Fraser River sockeye salmon in all fisheries totalled 1,777,000 fish, including 1,439,000 fish caught by Canada, 297,000 fish caught by the U.S. and 40,000 fish caught by test fisheries (Table 8). Most of the Canadian catch occurred in First Nations FSC fisheries (Food, Social and Ceremonial, 850,000 fish), followed by commercial (includes First Nation Economic Opportunity and Demonstration fisheries, 449,000 fish) and recreational fisheries (102,000 fish). In Washington, commercial catches totalled 266,000 Fraser sockeye, mostly caught in Treaty Indian fisheries (181,000 fish). Fisheries in Alaska harvested 18,000 Fraser sockeye. The overall harvest rate was 35% of the run, which is within the range observed since the mid 1990s (Figure 8).
15. DFO's near-final estimates of spawning escapements to streams in the Fraser River watershed totalled 2,580,000 adult sockeye (Tables 8 and 9). This was about 2½ times the brood year escapement of 887,000 adults and the second highest escapement for this cycle on record. By management group and for this cycle line, spawning escapements in 2011 were the lowest to the Early Stuart system since at least 1939, highest Early Summer escapement since 1991, and similar Summer-run escapement as recent years, highest Harrison escapement on record and similar Late-run escapement as in recent years (Figure 10). There were 1,165,000 effective female spawners in the Fraser watershed, representing an overall spawning success of 81%.
16. The in-season run-size estimate of 18,300,000 Fraser River pink salmon was revised post-season to 20,649,000 fish, making it 18% larger than forecasted and the 4th largest Fraser River pink salmon run since at least 1959 when records began. Catches totalled 7,861,000 fish, with 4,931,000 caught by Canada, 2,916,000 by the U.S. and 13,000 in test fisheries (Table 8). This catch represents an exploitation rate of 38% (Table 9), which is the largest since 1997.
17. Between 2003 and 2007, the run size of Fraser River pink salmon was the adopted in-season estimate while spawner abundance was calculated by subtracting total catch from this run size. Since 2009, post-season estimates of pink salmon passage have been obtained through the hydroacoustics system at Mission. In 2011, the run size of Fraser River pink salmon was calculated by adding the total catch of pink salmon below Mission (6,947,000 fish) to the Mission passage estimate (13,702,000 fish, Table 7), while the spawner abundance (12,788,000 fish) was calculated by subtracting 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). In-season estimates of potential escapement (i.e., Mission escapement minus all catch above Mission) were close to the target for Early Stuart sockeye (8% under), and higher than the targets for Early Summer (18% over), Summer (24% over), Harrison (46% over) and Late-run (40% over) sockeye (Table 14).
20. Spawning ground estimates of Fraser sockeye abundance totalled 2,580,000 adults, which is 25% above the post-season target. Spawner abundance was severely below the target for Early Stuart sockeye (96% under), close to the target for Early Summer (1% over), and over the target for Summer (30% over), Harrison (45% over) and Late-run management groups (9% over) (Table 15). More than ninety percent of the Early Stuart run was protected from harvest. Thus the poor result on the spawning grounds was likely a consequence of elevated levels of en route mortality due to the very high discharge levels in the Fraser River during the Early Stuart migration period (Figure 6).

21. The TAC (Total Allowable Catch) of Fraser sockeye was 2,078,000 fish (Table 16), based on the calculation method set out in Annex IV, Chapter 4 of the Pacific Salmon Treaty and the February 17, 2011 Commission Guidance (Appendix C). The Washington catch of 279,000 Fraser sockeye was 64,000 fish less than their 16.5% share. Similarly, the total Canadian catch of 1,405,000 Fraser sockeye (excluding the ESSR catch of 34,000 Weaver sockeye) was 730,000 fish less than their in-season catch goal (83.5% of TAC + 400,000 fish AFE). In these calculations, the TAC is fixed on the date that Panel control of the last U.S. Panel Area was relinquished (October 8 in 2011), while catches are post-season estimates.
22. In terms of domestic allocation objectives for Fraser sockeye, Treaty Indian fishers were 38,000 fish under and All Citizen fishers were 26,000 fish under their shares of the U.S. TAC (Table 17).
23. The spawning escapement target for Fraser pink salmon was exceeded by 6,788,000 fish (Table 15), largely because the catch of Fraser pink salmon was constrained by conservation measures to protect Late-run sockeye.
24. The U.S. catch of Fraser pink salmon was 241,000 fish less than their 25.7% share of the international TAC and the Canadian catch was 4,198,000 fish less than their catch goal (Table 16).
25. Regarding domestic allocation objectives for Fraser pink salmon, Treaty Indian and All Citizen fishers were respectively 161,000 and 80,000 fish under their shares of the U.S. TAC (Table 18).
26. By-catches of non-Fraser sockeye and pink salmon in commercial net fisheries regulated by the Fraser River Panel totalled 470 sockeye and 748,000 pink salmon (Table 19). Catches of other Fraser and non-Fraser salmon species included 11,400 chinook, 4,000 coho, 500 chum and 10 steelhead.

Allocation Status

27. There are no paybacks of Fraser River sockeye or pink salmon to carry forward to 2012 (Table 20).

II. FRASER RIVER PANEL

In 2011, 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 and the February 2011 “Commission Guidance to the Fraser River Panel” (Appendix C). 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. 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.

¹ Pacific Salmon Commission. 2009. Report of the Fraser River Panel to the Pacific Salmon Commission on the 2005 Fraser River sockeye and pink salmon fishing season. Appendix A. Vancouver, B.C.

Implicit to the proposed regime is the principle that all Panel-regulated fisheries are to remain closed (Appendix F) unless opened by specific order (Appendix G). The pre-season plan identifies the approximate pattern of fishery openings required to achieve 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 (Staff, Appendix H) 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 Panel Technical Committee (Appendix J) works in conjunction with Staff to facilitate Panel activities by providing their respective National sections with technical advice and ensuring timely exchange of data between Staff and the Parties.

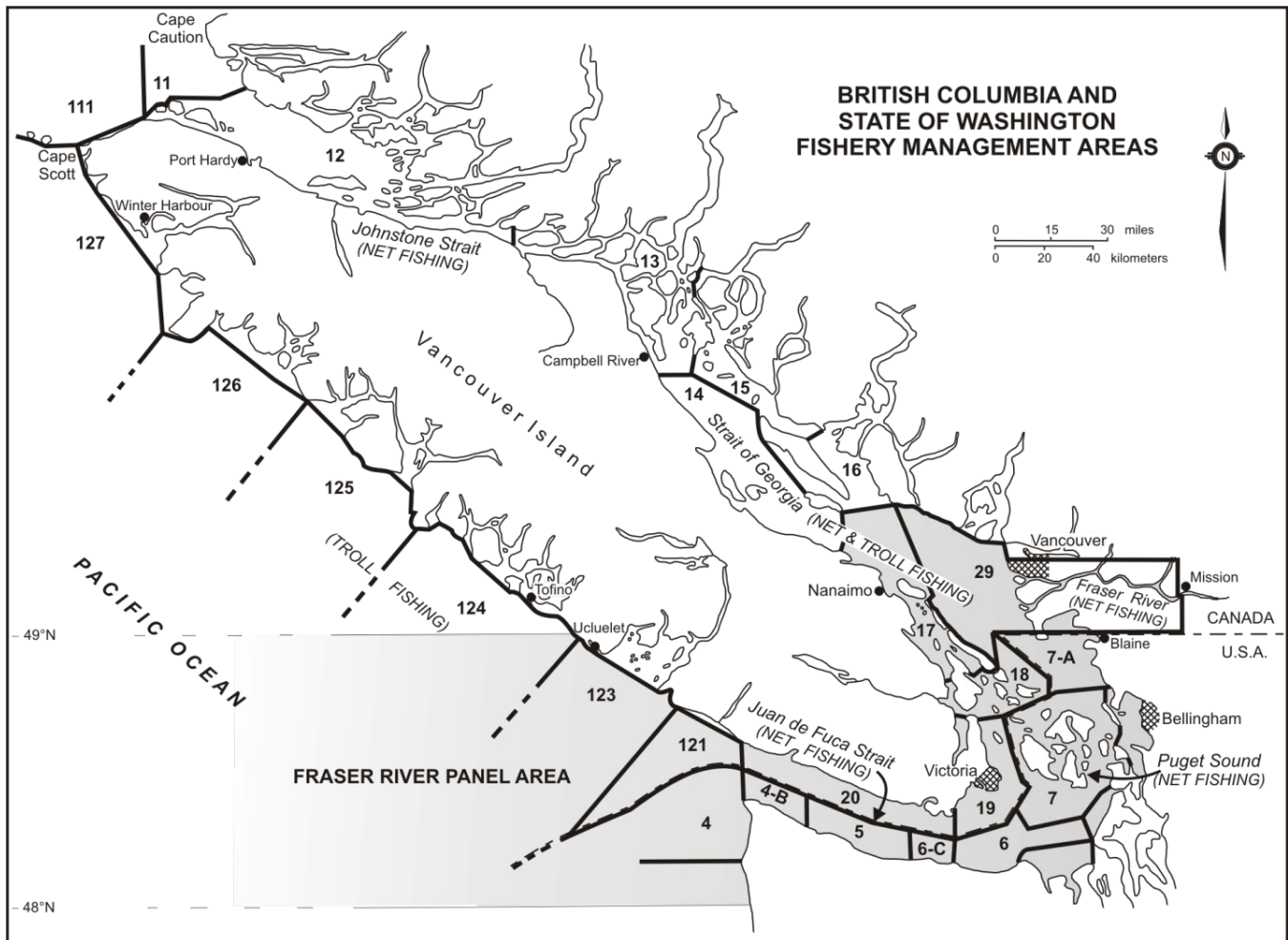


Figure 1. Fishery management areas in the Fraser River Panel Area and Canada's south coast waters.

III. PANEL MANAGEMENT ACTIVITIES

Information used for Panel management can be divided into three general categories: (1) pre-season forecasts and expectations, on which pre-season planning activities and the management plan are based; (2) in-season estimates that develop 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. Key information in these categories is discussed in the following sections.

A. Pre-season Planning

Pre-season plans for Panel Area fisheries were developed by the Panel using the Fishery Simulation Model², 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 and MAs, plus objectives for spawning escapement and catch allocation. Inputs to the “base case” planning model are summarized in the “June 15-16 Pre-season” date segment in Table 1.

Both countries evaluated fishing plans that included directed sockeye (primarily Summer-run) and pink salmon fisheries. Impacts on Late-run (including Cultus) sockeye constrained the ability of either country to achieve their pink salmon TAC, while fisheries early in the season were constrained to protect Early Stuart sockeye. In the modelling, release mortalities for sockeye captured and released during pink-directed fisheries were factored into estimates of exploitation rate but excluded from total landings used to evaluate catches relative to TAC shares. Alternative model runs explored the sensitivity of fishing plans to changes in northern diversion, run size and available exploitation rates on Late-run sockeye.

Preliminary run-size forecasts for Fraser River sockeye salmon were produced by Canada using an assumption of low productivity as observed in recent recruit-per-spawner trends. Pink run-size forecasts were produced using a long-term average productivity scenario³. Canada presented the panel with preliminary sockeye and pink run-size forecasts at different probability levels (10%, 25%, 50%, 75% and 90%), indicating the probability that the number of returning salmon will be below, or at, the specified abundance (Appendix B, Table B1). The Panel used the median (i.e., p50 or 50% probability level) forecast of 3.2 million Fraser River sockeye and 17.5 million Fraser River pinks as the “base case” scenario for planning purposes, thereby accepting equal probability that the actual runs would be above or below the forecast. Alternative scenarios also explored 75% probability level (i.e., higher) abundances for sockeye and pink salmon. Alternative scenarios at lower abundance levels were not explored because the available harvests were too low to warrant detailed model evaluation (Appendix B, Table B2).

Canada used the “Fraser River Sockeye Spawning Initiative” (FRSSI) model to establish escapement goals for the 2011 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 Canadian domestic consultation process. Pre-season escapement targets for sockeye salmon at the median forecasted run sizes were: 17,000 Early Stuart, 181,200 Early Summer, 600,000 Summer and 482,800 Late-run fish⁴. For pink salmon the pre-season escapement target was 6,000,000.

Pre-season fisheries management planning was based on assumptions about the marine migration patterns of Fraser sockeye and pink salmon, including marine timing (i.e., Area 20 50% migration date) and the proportions that would migrate through Johnstone Strait versus Juan de Fuca Strait (i.e., the Johnstone Strait diversion rate, Figure 2), as forecasted by DFO. 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. Run timing forecasts for Early Stuart and Chilko stocks were forecasted by DFO using the combination of Gulf of Alaska sea surface temperatures and ocean current predictions generated by the Ingraham model⁵. A median forecasted Area 20 timing of August 7 for Chilko and a median forecasted Below Bridge (New Westminster) timing of July 4 (which is equivalent to an Area 20 date of June 29) for Early Stuart were applied in the “base case” model. These marine

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 Grant, S.C.H. and MacDonald, B.L. 2012. Pre-season run size forecasts for Fraser River Sockeye (*Oncorhynchus nerka*) and Pink (*O. gorbuscha*) salmon in 2011. DFO. Can. Sci. Advis. Sec. Res. Doc. 2011/134. vi + 48p.

⁴ 2011/2012 Southern B.C. Salmon Integrated Fishery Management Plan. Fisheries and Oceans Canada.

⁵ Thomson, R., Ingraham, W.J., Healey, M.C., LeBlond, P.H., Groot, C., and Healey, C.G. 1994. Computer simulations of the influence of ocean currents on Fraser River sockeye salmon (*Oncorhynchus nerka*) return times. Can. J. Fish. Aquat. Sci. 51: 441-449.

dates represent near-normal timing for Chilko and earlier than normal timing for Early Stuart (historical median Area 20 date is July 4). Area 20 timing for the remaining sockeye stocks were calculated as a function of Early Stuart or Chilko timing using historical regression models or historical cycle-line medians. For planning purposes, the Panel used Area 20 dates of July 31 for Early Summers, August 7 for Summers and August 11 for Lates. DFO used sea surface temperatures from Kains Island to forecast a Johnstone Strait diversion rate of 32% for Fraser sockeye.

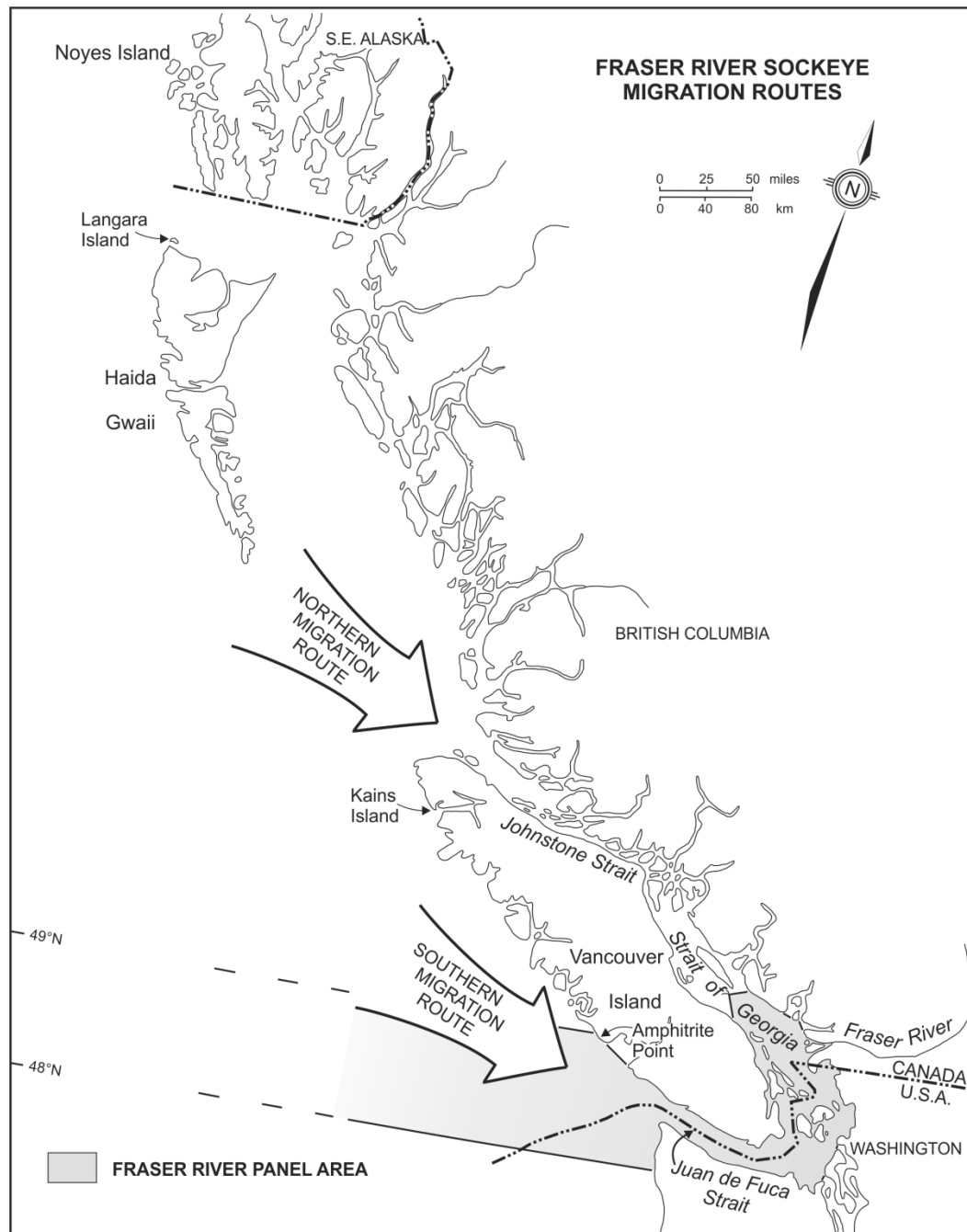


Figure 2. The northern (Johnstone Strait) and southern (Juan de Fuca Strait) routes for sockeye and pink salmon migration to the Fraser River.

For pink salmon, historical data were used to produce a timing forecast of August 29 and a diversion rate forecast of 46% (later revised to 59%). Pink timing was forecasted from the combination of predicted currents from the Ingraham model⁵ and the current year pink body size from early-season catches in lower Fraser River test fisheries. However, due to the low

explanatory power of the relationship and the fact that observed timings were earlier than predicted in recent years, an Area 20 timing of August 25 based on historical timing data (mean timing for 2003, 2005, 2007 and 2009) was used for pink salmon. The Johnstone Strait diversion rate for pink salmon was forecasted from a Bakun upwelling index combined with Kains Island sea surface salinity. Figures 3 and 4 illustrate the marine distributions (Area 20 date) of daily abundances for each sockeye group and for pink salmon given the pre-season assumptions of timing and run size.

To model Late-run migratory behaviour into the Fraser River, a 50% Mission date (i.e., date when 50% of the run was expected to pass Mission) of August 21 was adopted, based on an August 11 Area 20 50% date for the Late-run aggregate and an assumed 3-week delay in the Strait of Georgia by 40% of the Late Shuswap/Portage and Weaver/Cultus stocks. The Area 20 date was calculated from a weighted average of the projected Area 20 dates for the separate Late-run stock components (August 5 for Harrison, August 14 for Birkenhead and other Late-run stocks). Delaying fish are assumed to interrupt their migration and reside in the Strait of Georgia for a period of time, while the “early timed” Late-run component, including Birkenhead, Harrison and the remaining Late Shuswap/Portage and Weaver/Cultus fish, are assumed to migrate directly from marine areas into the river with no delay in the Strait of Georgia.

DFO’s Environmental Watch Program provided the Panel with long-range (3-month) projections of Fraser River temperature and discharge conditions. Forecasts projected above-average discharge and near-normal water temperatures 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 median MA forecasts for each management group were adopted by the Panel: Early Stuart pMA = 1.23 (20,900 fish); Early Summer pMA = 0.21 (38,100 fish); and Summer pMA = 0. Pre-season planning assumed early upstream migration of Late-run sockeye salmon. As a result, the Panel adopted a pMA of 0.69 (333,100 fish) for Late-run sockeye, which is equivalent to the median of the three most recent MAs on the current cycle line (1999, 2003, 2007) for all Late-timed stocks combined (i.e., including Harrison and Birkenhead), and corresponds to an upstream migration date at Mission of August 27 (i.e., the upstream timing in 2003, the year associated with the median pMA).

The Panel considered five alternative planning scenarios that included variations in the assumed sockeye and pink salmon run sizes, northern diversion rate of Fraser sockeye and Late-run management strategy. Under the “base case” scenario, the Late-run exploitation rate with an assumed pMA of 0.69 was 32%. An alternative Late-run management scenario consisted of a maximum total Late-run exploitation rate of 20%. Both countries evaluated fishing plans that contained pink salmon-directed fisheries and operated within Fraser sockeye constraints.

Canada and the U.S. developed a management plan under the “base case” conditions described above, with the first potential salmon fisheries directed at Fraser sockeye commencing in the weeks of July 31 in Canadian Panel-Area waters and July 24 in the U.S. The management plan included the “Management Plan Principles and Constraints”, “Guidelines to Address Late Run Concerns” and “2011 Regulations” (Appendices D, E and F). Due to conservation concerns, a 3-week moving window for closure of fisheries on Early Stuart sockeye and a one-week moving window closure for Early Summer sockeye restricted fishery openings for earlier dates. Within the pre-season plan, fisheries directed at Fraser pink salmon were initiated in the 3rd and 4th weeks of August for Canada and the U.S., respectively. During proposed Individual Transferable Quota (ITQ) fisheries for pink salmon, Canada assumed sockeye non-retention and applied gear-specific fishing-induced mortalities to any sockeye encounters (25% mortality for seine, 10% for troll and 60% for gillnet fisheries). The U.S. assumed full sockeye retention in all fisheries. Fishing-induced mortalities for released sockeye were not counted against the TAC but were incorporated into estimates of total exploitation rate. If in-season assessments indicated that return abundances of sockeye or pink salmon 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 fisheries as well as the

assumptions about sockeye retention and fishing-induced mortalities could deviate from the proposed plan.

Calculations of TACs and international harvest shares for Fraser sockeye and pinks were based on the 2005 revised Annex IV, Chapter 4 of the Pacific Salmon Treaty and the February 17, 2011 Commission Guidance to the Fraser River Panel (Appendix C). The pre-season TAC for international sharing was 1,095,000 sockeye (Table 1), of which the 16.5% U.S. (Washington) share was 181,000 fish. Treaty Indian fishers were allocated 67.7% of the U.S. TAC and All Citizen fishers the remaining 32.3%. The Canadian allowable harvest plus the 400,000 Aboriginal Fishery Exemption (AFE) was 1,314,000 sockeye. Pre-season catch targets for non-commercial fisheries in Canada totalled 1,013,000 sockeye, including 992,000 fish for First Nations FSC fisheries and 21,000 fish for recreational fisheries. The remaining Canadian sockeye share (301,000 sockeye based on pre-season expectations) was to be divided within the commercial sector (includes First Nations EO (Economic Opportunity) and Demo (Demonstration) fisheries). Allocation shares by commercial fishing area and gear were: 48.5% for Area B purse seines, 21.5% for Area D gillnets, 25.0% for Area E gillnets and 5% for Area H trollers.

For pink salmon, the total TAC for international sharing was 11,485,000. The U.S. share was 25.7% of the TAC or 2,952,000 fish. The Canadian allowable harvest was 8,533,000 fish, including 800,000 allocated to in-river First Nations economic opportunity fisheries. Canadian pre-season non-commercial catch targets totalled 130,000 fish, including 15,000 fish for First Nations FSC fisheries plus projected recreational catches of 115,000 fish. For the commercial sector, the remaining 8,400,000 pinks was to be distributed as follows: 65% for Area B purse seines, 10% for Area D gillnets, 10.5% for Area E gillnets, 6.5% for Area G trollers and 8% 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 sockeye and pink salmon. Canada identified Cultus and Sakinaw sockeye, Thompson River steelhead, interior Fraser River coho and early-timed Chinook salmon (particularly Fraser River stocks). The U.S. highlighted concerns for Lake Washington sockeye, three listed Chinook stocks, Hood Canal summer-run chum, three listed species of rockfish, eulachon, green sturgeon and southern resident killer whales.

B. In-season Management

In 2011, all sockeye and pink salmon management groups returned at run sizes that were near to or greater than the median pre-season forecasts, and with marine timing near to or later than forecasted (Figures 3 and 4). Perhaps most notably, the abundance of Harrison sockeye exceeded the median forecast by approximately 1,000,000 fish and returned with a protracted migration. Additional management challenges arose due to the application of directed pink salmon fisheries with optional sockeye retention, which increased the complexity of evaluating new fisheries plans. Exceptionally high flows in the Fraser River introduced concerns regarding in-river survival of early-migrating sockeye and presented logistical challenges for in-river hydroacoustic and test-fishing programs. The Panel responded to these challenges in-season by modifying management adjustments and fishing plans accordingly. The large Harrison return caused the Panel to separate Harrison from the remaining stocks in the Late-run group in mid-August, and to use a different management adjustment for Harrison in subsequent calculations.

The Panel convened 27 times between July 15 and September 29, to discuss run status and enact in-season Orders (Appendix G) 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 components that result in the calculated TAC (i.e., spawning escapement target, MA, projected test fishery catch and Aboriginal Fishery Exemption). Also shown are estimates of available harvest (run size minus spawning escapement target and MA), catch to date, Mission escapement to date and 50% migration dates. The last date shown in Table 1 (October 8) 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 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 target and other TAC-related values for Fraser River sockeye and pink salmon in 2011. The available harvest (run size minus spawning escapement target and management adjustment), catch to date, Mission passage to date and migration timing are also shown.

Date	Management Group	Total Abundance	TAC					Available Harvest (incl. TF + AFE)	Catch to date	Mission Passage to date	50% Migration Date	
			Spawning Escapement Target	Management pMA	Adjust.	Test Fishing	Aboriginal Fishery Exemption	Total Allowable Catch			Area 20	Mission
June 15-16	Pre-season	Early Stuart	17,000	1.23	20,900	100	1,000	0	0	0	29-Jun	5-Jul
		Early Summer	453,000	0.21	38,100	6,200	46,800	180,700	233,700	0	31-Jul	6-Aug
		Summer	1,500,000	0.00	0	14,600	260,400	625,000	900,000	0	7-Aug	13-Aug
		Late (incl. Harrison)	1,207,000	0.69	333,100	10,200	91,800	289,100	391,100	0	11-Aug	21-Aug
		Sockeye	3,177,000		392,100	31,100	400,000	1,094,800	1,524,800	0		
		Pink	17,495,000		6,000,000	10,000		11,485,000	11,495,000	0	25-Aug	
July 15	In-season	Early Stuart	22,000	4.71	103,600	100	1,000	0	0	180	1-Jul	7-Jul
		Early Summer	453,000	0.21	38,100	6,200	46,800	180,700	233,700	330	31-Jul	6-Aug
		Summer	1,500,000	0.00	0	14,600	260,400	625,000	900,000	10	7-Aug	13-Aug
		Late (incl. Harrison)	1,207,000	0.69	333,100	10,200	91,800	289,100	391,100	80	11-Aug	21-Aug
		Sockeye	3,182,000		474,800	31,100	400,000	1,094,800	1,524,800	600	23,100	
		Pink	17,495,000		6,000,000	10,000		11,485,000	11,495,000	0	25-Aug	
July 19	In-season	Early Stuart	22,000	4.10	90,200	100	1,000	0	0	210	2-Jul	8-Jul
		Early Summer	453,000	0.21	38,100	6,200	46,800	180,700	233,700	550	31-Jul	6-Aug
		Summer	1,500,000	0.00	0	14,600	260,400	625,000	900,000	90	7-Aug	13-Aug
		Late (incl. Harrison)	1,207,000	0.69	333,100	10,200	91,800	289,100	391,100	260	11-Aug	21-Aug
		Sockeye	3,182,000		461,400	31,100	400,000	1,094,800	1,524,800	1,110	32,600	
		Pink	17,495,000		6,000,000	10,000		11,485,000	11,495,000	160	25-Aug	
July 22	In-season	Early Stuart	22,000	4.10	90,200	100	1,000	0	0	280	2-Jul	8-Jul
		Early Summer	453,000	0.21	38,100	6,200	46,800	180,700	233,700	1,530	31-Jul	6-Aug
		Summer	1,500,000	0.00	0	14,600	260,400	625,000	900,000	380	7-Aug	13-Aug
		Late (incl. Harrison)	1,207,000	0.69	333,100	10,200	91,800	289,100	391,100	600	11-Aug	21-Aug
		Sockeye	3,182,000		461,400	31,100	400,000	1,094,800	1,524,800	2,790	43,490	
		Pink	17,495,000		6,000,000	10,000		11,485,000	11,495,000	440	25-Aug	
July 25	In-season	Early Stuart	22,000	4.10	90,200	100	1,000	0	0	270	2-Jul	8-Jul
		Early Summer	453,000	0.21	38,100	6,200	46,800	180,700	233,700	2,530	31-Jul	6-Aug
		Summer	1,500,000	0.00	0	14,600	260,400	625,000	900,000	960	7-Aug	13-Aug
		Late (incl. Harrison)	1,207,000	0.69	333,100	10,200	91,800	289,100	391,100	1,910	11-Aug	21-Aug
		Sockeye	3,182,000		461,400	31,100	400,000	1,094,800	1,524,800	5,670	62,280	
		Pink	17,495,000		6,000,000	10,000		11,485,000	11,495,000	880	25-Aug	
July 26	In-season	Early Stuart	22,000	4.10	90,200	100	1,000	0	0	270	2-Jul	8-Jul
		Early Summer	453,000	0.21	38,100	6,200	46,800	180,700	233,700	2,660	31-Jul	6-Aug
		Summer	1,500,000	0.00	0	14,600	260,400	625,000	900,000	1,390	7-Aug	13-Aug
		Late (incl. Harrison)	1,207,000	0.69	333,100	10,200	91,800	289,100	391,100	2,660	11-Aug	21-Aug
		Sockeye	3,182,000		461,400	31,100	400,000	1,094,800	1,524,800	6,980	81,050	
		Pink	17,495,000		6,000,000	10,000		11,485,000	11,495,000	950	25-Aug	
July 29	In-season	Early Stuart	23,000	4.10	94,300	100	1,000	0	0	280	2-Jul	8-Jul
		Early Summer	453,000	0.21	38,100	6,200	46,800	180,700	233,700	5,320	31-Jul	6-Aug
		Summer	1,500,000	0.00	0	14,600	260,400	625,000	900,000	3,950	7-Aug	13-Aug
		Late (incl. Harrison)	1,207,000	0.69	333,100	10,200	91,800	289,100	391,100	5,120	11-Aug	21-Aug
		Sockeye	3,183,000		465,500	31,100	400,000	1,094,800	1,524,800	14,670	139,970	
		Pink	17,495,000		6,000,000	10,000		11,485,000	11,495,000	1,520	25-Aug	
August 2	In-season	Early Stuart	23,000	4.10	94,300	100	1,000	0	0	490	2-Jul	8-Jul
		Early Summer	453,000	0.21	38,100	6,200	46,800	180,700	233,700	13,100	31-Jul	6-Aug
		Summer	1,500,000	0.00	0	14,600	260,400	625,000	900,000	9,920	7-Aug	13-Aug
		Late (incl. Harrison)	1,207,000	0.69	333,100	10,200	91,800	289,100	391,100	11,990	11-Aug	21-Aug
		Sockeye	3,183,000		465,500	31,100	400,000	1,094,800	1,524,800	35,500	267,400	
		Pink	17,495,000		6,000,000	10,000		11,485,000	11,495,000	1,230	25-Aug	
August 3	In-season	Early Stuart	23,000	4.10	94,300	100	1,000	0	0	460	2-Jul	8-Jul
		Early Summer	453,000	0.21	38,100	6,200	46,800	180,700	233,700	13,150	31-Jul	6-Aug
		Summer	1,500,000	0.00	0	14,600	260,400	625,000	900,000	11,070	7-Aug	13-Aug
		Late (incl. Harrison)	1,207,000	0.69	333,100	10,200	91,800	289,100	391,100	12,330	11-Aug	21-Aug
		Sockeye	3,183,000		465,500	31,100	400,000	1,094,800	1,524,800	37,010	328,800	
		Pink	17,495,000		6,000,000	10,000		11,485,000	11,495,000	1,320	25-Aug	

Table 1, continued on next page

Table 1, continued.

			TAC						Available			50% Migration Date		
			Spawning Escapement		Management	Test	Aboriginal Fishery	Total Allowable	Harvest (incl'd. TF + AFE)	Catch to date	Mission Passage to date			
Date	Management Group	Total Abundance	Target	pMA	Adjust.	Fishing	Exemption	Catch				Area 20	Mission	
August 5	In-season	Early Stuart	25,000	25,000	4.10	102,500	200	1,000	0	0	690	24,150	2-Jul	8-Jul
		Early Summer	453,000	181,200	0.46	83,400	6,200	46,800	135,400	188,400	33,220	177,460	31-Jul	6-Aug
		Summer	1,500,000	600,000	0.00	0	14,600	260,400	625,000	900,000	41,010	116,620	7-Aug	13-Aug
		Late (incl'ds Harrison)	1,207,000	482,800	0.69	333,100	10,200	91,800	289,100	391,100	37,510	144,740	11-Aug	21-Aug
		Sockeye	3,185,000	1,289,000		519,000	31,200	400,000	1,049,500	1,479,500	112,430	462,970		
		Pink	17,495,000	6,000,000			10,000		11,485,000	11,495,000	2,080		25-Aug	
August 8	In-season	Early Stuart	25,000	25,000	4.10	102,500	200	1,000	0	0	720	24,220	2-Jul	8-Jul
		Early Summer	453,000	181,200	0.46	83,400	6,200	46,800	135,400	188,400	50,580	214,520	31-Jul	6-Aug
		Summer	1,500,000	600,000	0.00	0	14,600	260,400	625,000	900,000	132,470	167,690	7-Aug	13-Aug
		Late (incl'ds Harrison)	1,207,000	482,800	0.69	333,100	10,200	91,800	289,100	391,100	111,170	211,590	11-Aug	21-Aug
		Sockeye	3,185,000	1,289,000		519,000	31,200	400,000	1,049,500	1,479,500	294,940	618,020		
		Pink	17,495,000	6,000,000			10,000		11,485,000	11,495,000	9,160		25-Aug	
August 9	In-season	Early Stuart	25,000	25,000	4.10	102,500	200	1,000	0	0	710	24,240	2-Jul	8-Jul
		Early Summer	453,000	181,200	0.46	83,400	6,200	46,800	135,400	188,400	54,850	243,110	31-Jul	6-Aug
		Summer	1,500,000	600,000	0.00	0	14,600	260,400	625,000	900,000	139,750	210,070	7-Aug	13-Aug
		Late (incl'ds Harrison)	1,207,000	482,800	0.69	333,100	10,200	91,800	289,100	391,100	112,450	228,570	11-Aug	21-Aug
		Sockeye	3,185,000	1,289,000		519,000	31,200	400,000	1,049,500	1,479,500	307,760	705,990		
		Pink	17,495,000	6,000,000			10,000		11,485,000	11,495,000	9,250		25-Aug	
August 12	In-season	Early Stuart	25,000	25,000	4.10	102,500	200	1,000	0	0	800	24,270	2-Jul	8-Jul
		Early Summer	480,000	192,000	0.39	74,900	6,200	46,800	160,100	213,100	80,020	301,170	1-Aug	7-Aug
		Summer	2,000,000	800,000	0.00	0	14,600	260,400	925,000	1,200,000	226,300	337,320	11-Aug	17-Aug
		Late (incl'ds Harrison)	1,475,000	590,000	0.69	407,100	10,200	91,800	375,900	477,900	194,040	399,030	11-Aug	21-Aug
		Sockeye	3,980,000	1,607,000		584,500	31,200	400,000	1,461,000	1,891,000	501,160	1,061,790		
		Pink	17,495,000	6,000,000			10,000		11,485,000	11,495,000	23,950		25-Aug	
August 15	In-season	Early Stuart	25,000	25,000	4.10	102,500	200	1,000	0	0	760	24,300	2-Jul	8-Jul
		Early Summer	480,000	192,000	0.39	74,900	6,200	46,800	160,100	213,100	85,990	340,200	1-Aug	7-Aug
		Summer	2,000,000	800,000	0.00	0	14,600	260,400	925,000	1,200,000	283,920	476,520	11-Aug	17-Aug
		Late (incl'ds Harrison)	1,475,000	590,000	0.69	407,100	10,200	91,800	375,900	477,900	249,840	473,700	11-Aug	21-Aug
		Sockeye	3,980,000	1,607,000		584,500	31,200	400,000	1,461,000	1,891,000	620,510	1,314,720		
		Pink	17,495,000	6,000,000			10,000		11,485,000	11,495,000	39,880		25-Aug	
August 16	In-season	Early Stuart	25,000	25,000	4.10	102,500	200	1,000	0	0	780	24,300	2-Jul	8-Jul
		Early Summer	480,000	192,000	0.39	74,900	6,200	46,800	160,100	213,100	94,210	347,470	1-Aug	7-Aug
		Summer	2,000,000	800,000	0.00	0	14,600	260,400	925,000	1,200,000	326,720	503,190	11-Aug	17-Aug
		Late (incl'ds Harrison)	1,475,000	590,000	0.69	407,100	10,200	91,800	375,900	477,900	276,570	532,700	11-Aug	21-Aug
		Sockeye	3,980,000	1,607,000		584,500	31,200	400,000	1,461,000	1,891,000	698,280	1,407,660		
		Pink	17,495,000	6,000,000			10,000		11,485,000	11,495,000	48,260		25-Aug	
August 19	In-season	Early Stuart	25,000	25,000	4.10	102,500	200	1,000	0	0	1,850	24,810	2-Jul	8-Jul
		Early Summer	480,000	192,000	0.39	74,900	7,000	46,800	159,300	213,100	138,590	339,290	1-Aug	7-Aug
		Summer	1,600,000	640,000	0.00	0	14,600	260,400	685,000	960,000	404,420	571,940	11-Aug	17-Aug
		Harrison	850,000	340,000	0.38	129,200	10,000	27,540	343,260	380,800	169,810	554,360	4-Aug	
		Late	1,100,000	440,000	0.69	303,600	8,000	64,260	284,140	356,400	132,750	160,030		
		Sockeye	4,055,000	1,637,000		610,200	39,800	400,000	1,471,700	1,910,300	847,420	1,650,430		
Pink	17,495,000	6,000,000			10,000		11,485,000	11,495,000	80,860		25-Aug			
August 23	In-season	Early Stuart	25,000	25,000	4.10	102,500	200	1,000	0	0	1,960	24,810	2-Jul	8-Jul
		Early Summer	480,000	192,000	0.39	74,900	7,000	46,800	159,300	213,100	153,660	357,210	1-Aug	7-Aug
		Summer	1,600,000	640,000	0.00	0	14,600	260,400	685,000	960,000	498,820	774,580	11-Aug	17-Aug
		Harrison	850,000	340,000	0.38	129,200	10,000	27,540	343,260	380,800	189,780	626,160	4-Aug	
		Late	1,240,000	496,000	0.46	228,200	8,000	64,260	443,540	515,800	176,680	237,280		
		Sockeye	4,195,000	1,693,000		534,800	39,800	400,000	1,631,100	2,069,700	1,020,900	2,020,040		
Pink	17,495,000	6,000,000			10,000		11,485,000	11,495,000	143,110		25-Aug			
August 26	In-season	Early Stuart	25,000	25,000	4.10	102,500	200	1,000	0	0	1,860	24,810	2-Jul	8-Jul
		Early Summer	480,000	192,000	0.39	74,900	7,000	46,800	159,300	213,100	165,820	378,810	1-Aug	7-Aug
		Summer	1,600,000	640,000	0.00	0	14,600	260,400	685,000	960,000	576,040	836,990	11-Aug	17-Aug
		Harrison	950,000	380,000	0.38	144,400	10,000	27,540	388,060	425,600	221,400	692,320	6-Aug	
		Late	1,240,000	496,000	0.46	228,200	8,000	64,260	443,540	515,800	223,900	263,700	15-Aug	
		Sockeye	4,295,000	1,733,000		550,000	39,800	400,000	1,675,900	2,114,500	1,189,020	2,196,630		
Pink	17,495,000	6,000,000			10,000		11,485,000	11,495,000	521,520		26-Aug			

Table 1, continued.

Date	Management Group	Total Abundance	TAC						Available Harvest			50% Migration Date	
			Spawning Escapement Target	Manage-ment pMA	Test Adjust.	Aboriginal Fishery Exemption	Total Allowable Catch	Mission Passage to date	Harvest (includ. TF + AFE)	Catch to date	Mission Passage to date	Area 20	Mission
August 29	In-season	Early Stuart	25,000	4.10	102,500	200	1,000	0	0	1,860	24,810	2-Jul	8-Jul
		Early Summer	500,000	0.39	78,000	7,000	46,800	168,200	222,000	170,360	395,080	1-Aug	7-Aug
		Summer	1,450,000	0.00	0	14,600	260,400	595,000	870,000	605,290	882,970	10-Aug	16-Aug
		Harrison	950,000	0.38	144,400	10,000	27,540	388,060	425,600	227,530	691,780	6-Aug	
		Late	1,240,000	0.46	228,200	8,000	64,260	443,540	515,800	267,390	284,140	15-Aug	
		Sockeye	4,165,000		553,100	39,800	400,000	1,594,800	2,033,400	1,272,430	2,278,780		
		Pink	17,495,000		6,000,000	10,000		11,485,000	11,495,000	1,117,690		26-Aug	
September 1	In-season	Early Stuart	25,000	4.10	102,500	200	1,000	0	0	1,860	24,810	2-Jul	8-Jul
		Early Summer	520,000	0.39	81,100	7,000	46,800	177,100	230,900	179,410	410,070	2-Aug	8-Aug
		Summer	1,500,000	0.00	0	14,600	260,400	625,000	900,000	709,880	935,010	10-Aug	16-Aug
		Harrison	950,000	0.38	144,400	10,000	27,540	388,060	425,600	251,250	706,790	6-Aug	
		Late	1,300,000	0.35	182,000	8,000	64,260	525,740	598,000	299,330	302,300	15-Aug	
		Sockeye	4,295,000		510,000	39,800	400,000	1,715,900	2,154,500	1,441,730	2,378,980		
		Pink	17,495,000		6,000,000	10,000		11,485,000	11,495,000	2,087,650		26-Aug	
September 2	In-season	Early Stuart	25,000	4.10	102,500	200	1,000	0	0	1,860	24,810	2-Jul	8-Jul
		Early Summer	520,000	0.39	81,100	7,000	46,800	177,100	230,900	178,870	415,670	2-Aug	8-Aug
		Summer	1,500,000	0.00	0	14,600	260,400	625,000	900,000	704,030	955,470	10-Aug	16-Aug
		Harrison	950,000	0.38	144,400	10,000	27,540	388,060	425,600	253,070	712,880	6-Aug	
		Late	1,300,000	0.35	182,000	8,000	64,260	525,740	598,000	305,960	310,450	15-Aug	
		Sockeye	4,295,000		510,000	39,800	400,000	1,715,900	2,154,500	1,443,790	2,419,280		
		Pink	17,495,000		6,000,000	10,000		11,485,000	11,495,000	2,172,660		26-Aug	
September 6	In-season	Early Stuart	25,000	4.10	102,500	200	1,000	0	0	1,860	24,810	2-Jul	8-Jul
		Early Summer	520,000	0.39	81,100	7,000	46,800	177,100	230,900	182,060	411,060	2-Aug	8-Aug
		Summer	1,500,000	0.00	0	14,600	260,400	625,000	900,000	721,320	994,660	10-Aug	16-Aug
		Harrison	950,000	0.38	144,400	10,000	27,540	388,060	425,600	257,420	727,210	6-Aug	
		Late	1,300,000	0.35	182,000	8,000	64,260	525,740	598,000	337,420	380,140	15-Aug	
		Sockeye	4,295,000		510,000	39,800	400,000	1,715,900	2,154,500	1,500,080	2,537,880		
		Pink	17,495,000		6,000,000	10,000		11,485,000	11,495,000	3,599,320		26-Aug	
September 8	In-season	Early Stuart	25,000	4.10	102,500	200	1,000	0	0	1,890	24,810	2-Jul	8-Jul
		Early Summer	570,000	0.39	88,900	7,000	46,800	199,300	253,100	188,810	455,910	2-Aug	8-Aug
		Summer	1,550,000	0.00	0	14,600	260,400	655,000	930,000	759,540	1,011,490	10-Aug	16-Aug
		Harrison	1,000,000	0.38	152,000	10,000	27,540	410,460	448,000	260,140	763,770	6-Aug	
		Late	1,325,000	0.35	185,500	8,000	64,260	537,240	609,500	351,190	464,200	15-Aug	
		Sockeye	4,470,000		528,900	39,800	400,000	1,802,000	2,240,600	1,561,570	2,720,180		
		Pink	17,495,000		6,000,000	10,000		11,485,000	11,495,000	4,609,270		26-Aug	
September 9	In-season	Early Stuart	25,000	4.10	102,500	200	1,000	0	0	1,880	24,810	2-Jul	8-Jul
		Early Summer	570,000	0.39	88,900	7,000	46,800	199,300	253,100	188,720	471,030	2-Aug	8-Aug
		Summer	1,550,000	0.00	0	14,600	260,400	655,000	930,000	757,000	1,022,100	10-Aug	16-Aug
		Harrison	1,000,000	0.38	152,000	10,000	27,540	410,460	448,000	260,420	778,080	6-Aug	
		Late	1,325,000	0.35	185,500	8,000	64,260	537,240	609,500	352,630	509,960	15-Aug	
		Sockeye	4,470,000		528,900	39,800	400,000	1,802,000	2,240,600	1,560,650	2,805,980		
		Pink	16,000,000		6,000,000	10,000		9,990,000	10,000,000	4,841,400		26-Aug	
September 12	In-season	Early Stuart	25,000	4.10	102,500	200	1,000	0	0	1,880	24,810	2-Jul	8-Jul
		Early Summer	590,000	0.39	92,000	7,000	46,800	208,200	262,000	189,630	465,080	4-Aug	10-Aug
		Summer	1,550,000	0.00	0	14,600	260,400	655,000	930,000	760,020	1,027,820	10-Aug	16-Aug
		Harrison	1,100,000	0.38	167,200	10,000	27,540	455,260	492,800	262,600	827,500	8-Aug	
		Late	1,325,000	0.35	185,500	8,000	64,260	537,240	609,500	362,050	716,470	15-Aug	
		Sockeye	4,590,000		547,200	39,800	400,000	1,855,700	2,294,300	1,576,180	3,061,680		
		Pink	17,500,000		6,000,000	10,000		11,490,000	11,500,000	5,921,530		26-Aug	
September 14	In-season	Early Stuart	25,000	4.10	102,500	200	1,000	0	0	1,880	24,810	2-Jul	8-Jul
		Early Summer	590,000	0.39	92,000	7,000	46,800	208,200	262,000	193,820	466,270	4-Aug	10-Aug
		Summer	1,550,000	0.00	0	14,600	260,400	655,000	930,000	776,970	1,030,050	10-Aug	16-Aug
		Harrison	1,100,000	0.38	167,200	10,000	27,540	455,260	492,800	264,090	833,960	8-Aug	
		Late	1,325,000	0.35	185,500	8,000	64,260	537,240	609,500	370,240	746,300	15-Aug	
		Sockeye	4,590,000		547,200	39,800	400,000	1,855,700	2,294,300	1,607,000	3,101,390		
		Pink	17,500,000		6,000,000	10,000		11,490,000	11,500,000	6,430,890		26-Aug	

Table 1, continued on next page

Table 1, continued.

			TAC						Available			50% Migration Date		
			Spawning Escapement		Manage-ment	Test	Aboriginal Fishery	Total Allowable	Harvest (incl. TF + AFE)	Catch to date	Mission Passage to date			
Date	Management Group	Total Abundance	Target	pMA	Adjust.	Fishing	Exemption	Catch				Area 20	Mission	
September 16	In-season	Early Stuart	25,000	25,000	4.10	102,500	200	1,000	0	0	1,880	24,810	2-Jul	8-Jul
		Early Summer	590,000	236,000	0.39	92,000	7,000	46,800	208,200	262,000	193,800	463,260	4-Aug	10-Aug
		Summer	1,550,000	620,000	0.00	0	14,600	260,400	655,000	930,000	778,040	1,034,200	10-Aug	16-Aug
		Harrison	1,100,000	440,000	0.38	167,200	10,000	27,540	455,260	492,800	265,820	866,960	8-Aug	
		Late	1,325,000	530,000	0.35	185,500	8,000	64,260	537,240	609,500	373,920	779,350	15-Aug	
		Sockeye	4,590,000	1,851,000		547,200	39,800	400,000	1,855,700	2,294,300	1,613,460	3,168,580		
		Pink	17,500,000	6,000,000			10,000		11,490,000	11,500,000	6,584,700		26-Aug	
September 29	In-season	Early Stuart	25,000	25,000	4.10	102,500	200	1,000	0	0	1,890	24,810	2-Jul	8-Jul
		Early Summer	571,000	228,400	0.39	89,100	7,000	46,800	199,700	253,500	194,650	463,260	4-Aug	10-Aug
		Summer	1,556,000	622,400	0.00	0	14,600	260,400	658,600	933,600	784,880	1,043,790	10-Aug	16-Aug
		Harrison	1,381,000	552,000	0.38	209,800	10,000	27,540	581,660	619,200	268,250	1,157,650	8-Aug	
		Late	1,544,000	618,000	0.35	216,300	8,000	64,260	637,440	709,700	381,630	1,218,570	15-Aug	
		Sockeye	5,077,000	2,045,800		617,700	39,800	400,000	2,077,400	2,516,000	1,631,300	3,908,080		
		Pink	18,300,000	6,000,000			10,000		12,290,000	12,300,000	7,757,200		26-Aug	
October 8	TAC Date *	Early Stuart	25,000	25,000	4.10	102,500	200	1,000	0	0	1,890	24,810	2-Jul	8-Jul
		Early Summer	571,000	228,400	0.39	89,100	7,000	46,800	199,700	253,500	194,650	463,260	4-Aug	10-Aug
		Summer	1,556,000	622,400	0.00	0	14,600	260,400	658,600	933,600	784,870	1,043,790	10-Aug	16-Aug
		Harrison	1,381,000	552,000	0.38	209,800	10,000	27,540	581,660	619,200	268,330	1,161,010	8-Aug	
		Late	1,544,000	618,000	0.35	216,300	8,000	64,260	637,440	709,700	381,570	1,223,210	15-Aug	
		Sockeye	5,077,000	2,045,800		617,700	39,800	400,000	2,077,400	2,516,000	1,631,310	3,916,080		
		Pink	18,300,000	6,000,000			10,000		12,290,000	12,300,000	7,599,500		26-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.

July 10 – 16: Due to cool, wet spring conditions, water levels in the lower Fraser River were above average for the time of year and water temperatures were below average. The high water levels disrupted the deployment and effectiveness of the hydroacoustic gear at Mission, so CPUE data from the Whonnock gillnet fishery was used to assess upstream passage. The high discharge resulted in an increased Early Stuart MA. Run-size assessments for Early Stuart were highly uncertain (80% prediction interval of 17,000 - 42,000 fish). About 85% of the run-to-date consisted of age 5 sockeye, which was a higher proportion than forecasted (the p50 forecast anticipated 65% age 5 fish). The Panel approved an Early Stuart run-size estimate of 22,000 fish (similar to the median run-size forecast of 17,000 fish) with marine migration timing (i.e., Area 20 date) of July 1. The Panel also approved an Early Stuart in-season pMA of 4.71.

July 17 – 23: High water levels in the lower Fraser persisted, affecting in-river assessment programs. Marine test fisheries indicated a steady migration of Fraser sockeye but it was too early to provide reliable assessments of Early Summer run size. Based on an assessment of later marine timing (July 2), the Panel adopted a reduced Early Stuart pMA of 4.10. Treaty Indian gillnet fisheries in U.S. Areas 4B, 5, 6C were approved since conditions were consistent with the criteria established pre-season for initiating these fisheries.

July 24 – 30: Samples from the Area 20 test fishery indicated a larger than expected proportion of Harrison sockeye and a lower than expected proportion of age 4₂ sockeye. Increasing proportions of Summer-run fish were also observed in marine test fisheries. Catches of pink salmon in Area 20 were reported. River test fisheries were dominated by Early Summer sockeye but Harrison fish were also present. High discharge levels in the Fraser River were still of concern. There was considerable uncertainty in Early Summer run-size estimates and it was too early to provide a formal Early Summer MA, but Staff noted that current and projected environmental conditions could result in a doubling of the pre-season pMA value of 0.21. The Panel adopted an increased Early Stuart run size of 23,000 fish and approved an extension of the Treaty Indian drift gillnet fishery in Areas 4B, 5 and 6C.

July 31 – August 6: Both Early Summer and Summer runs appeared to be tracking close to pre-season run-size forecasts but with later timing. The proportion of age 4₂ sockeye remained below expectations. River discharge remained above normal and produced turbidity-related difficulties for the observer counting salmon passage at Hells Gate. The Panel adopted an

increased Early Stuart run size of 25,000, adopted the p50 pre-season Early Summer run-size and timing forecasts as in-season estimates (453,000 fish and an Area 20 50% date of July 31), and adopted an Early Summer pMA of 0.46. Although it was too early for Staff to recommend a formal update to Summer-run abundance, the Panel agreed to work with a reduced run size of 1.1-1.2 million Summers for planning purposes. The Panel approved U.S. fishery proposals for Treaty Indian and All Citizen fisheries that were judged by Staff to be consistent with the available TAC.

August 7 – 13: Test fishery catches dropped off in Area 20 but increased in Johnstone Strait, resulting in an increased sockeye diversion rate estimate of 75%. Passage at Hells Gate was also strong although Mission escapement plateaued later in the week. The Early Summer migration was dropping off, except for the North Thompson component. Pink abundance was expected to build over the coming weeks. River discharge remained above average for the time of year and river temperatures remained below average. The Panel adopted the following updates: Early Summer run of 480,000 with August 1 marine timing and a pMA of 0.39; Summer run of 2,000,000 with August 11 timing, and Late run of 1,475,000 fish (640,000 Harrison and the p50 forecast of 835,000 non-Harrison Lates). Fisheries were approved in both U.S. (Treaty Indian and All Citizen) and Canadian Panel waters as anticipated catches were within the available TAC for each country.

August 14 – 20: Staff presented Summer-run estimates below the currently adopted run size of 2,000,000 fish, but noted that model estimates may be low if Summer-run fish were holding in the Strait of Georgia. Strait of Georgia troll fishery catches gave some indication of Late-run delay, which could translate into improved upstream survival. Staff reported a trend towards higher proportions of age 4₂ fish, both overall and by stock. Pink salmon abundance through Johnstone Strait started to increase, and consisted of 52% Fraser stocks. Pink salmon abundance was consistent with expectations at the p50 level but it was too early to report on timing. The Panel decided to manage Harrison separately from the other Late-run stocks (i.e., Late Shuswap/Weaver and Birkenhead, note change on August 19 in Table 1). The MA for the non-Harrison Late-run component was determined using a regression model that related historical DBE's for these stocks to their upstream timing. Thus, the Panel adopted pMAs of 0.38 for Harrison sockeye (median since 2004 excluding 2006 and 2010) and 0.69 for the Late Shuswap/Weaver and Birkenhead components. [See Appendix H, "Management adjustment and DBE" for further details on the MA approach adopted in-season for the Late-run aggregate.] The Panel approved the following updates: Summer run of 1,600,000 with August 11 marine timing; Harrison run of 850,000 with August 4 timing; Late Shuswap/Weaver run of 880,000 with August 14 timing; and Birkenhead run of 220,000 with August 16 timing. Fisheries were approved in both U.S. (Treaty Indian) and Canadian Panel waters.

August 21 – 27: Sockeye migration was slowing in marine areas, but pink migration was expected to continue. Pink salmon were observed in the Fraser River, however, estimates generated by the run-size models were still very uncertain (prediction intervals of 5 – 29 million). All Citizen fisheries in U.S. waters on August 24 reported that less than 10% of the total sockeye and pink salmon catch was sockeye. Proportions of Summer-run sockeye were decreasing in marine areas while Late-run proportions were increasing. There was still evidence of Late-run sockeye holding in the Strait of Georgia. The Panel adopted run-size updates of 950,000 Harrison (August 6 Area 20 timing) and 1,240,000 non-Harrison Late run sockeye. For the non-Harrison Lates the Panel also approved a Mission timing of September 5 and an associated pMA of 0.46. Both the U.S. and Canada proposed fisheries in Panel waters. Staff approved additional U.S. reefnet fisheries later in the week based on expectations of a small catch and minimal release mortality impacts. Concerns that Canada's proposed fisheries may impact Late-run sockeye holding in the Strait of Georgia were raised, but Canada stated that fisheries would be spatially restricted in Area 29 to avoid impact on Adams/Weaver sockeye holding there. Canada announced plans for First Nations Economic Opportunity fisheries in the Fraser River.

August 28 – September 3: Migrations of sockeye and pink salmon dropped off in both marine approaches, while daily abundances of pink salmon in the Fraser River increased substantially. Sockeye passage assessments switched from the use of Mission hydroacoustic data to Whonnock CPUE data, as is typically done in pink salmon years (odd years) when large abundances of pink salmon make it difficult to accurately estimate the proportion of sockeye

migrating upstream. Some Adams/Weaver sockeye still appeared to be delaying in the Strait of Georgia, which was an indicator that migration success may be better than expected pre-season. Summer-run stocks continued to dominate the sockeye present in the lower river. River discharge remained much higher than average for the time of year while river temperatures were only slightly below average. Staff based most recommendations for sockeye run-size updates on estimates of catch plus escapement to date plus projections of fish still en route in marine areas. Due to delayed upstream migration, however, run-size models based on marine migration data were still used to generate estimates of timing and abundance for Adams/Weaver sockeye. Staff advised that model-based estimates of pink salmon abundance were lower than the pre-season median forecast, but were likely biased low due to the bi-modal distribution of the migration and protracted duration of the run. The Panel adopted updated run sizes of 520,000 Early Summer sockeye (August 2 Area 20 timing) and 1,500,000 Summer sockeye (August 10 Area 20 timing). The Panel also adopted an upgraded Late-run abundance (Adams/Weaver/Birkenhead) of 1,300,000, based on Staff's recommendation to increase the Birkenhead run size to 300,000, given abundance indicators in river and marine areas. The Panel also adopted a Late-run pMA of 0.35, based on a predicted upstream (Mission) timing date of September 9. The Panel approved proposals for Treaty Indian and All Citizen fisheries in the U.S., and for Areas B (purse seine), E (gillnet) and H (troll) fisheries in Canadian Panel Areas. The U.S. All Citizen fishery was specified as non-retention for sockeye. U.S. Treaty Indian fisheries were allowed to retain sockeye for Ceremonial and Subsistence catch only (i.e., no commercial sales), and the Iwersen's Dock line boundary was in effect to reduce the catch of delaying sockeye. Canadian purse seine and troll fisheries were managed under an individual transferrable quota (ITQ), with voluntary sockeye release prior to September 3. Effective September 3, Area 29 purse seine fisheries switched to non-retention of sockeye. Staff commended both countries for adopting fishing plans that would limit impacts on Late-run sockeye holding in the Strait of Georgia.

September 4 – 10: There was evidence of Late-run sockeye still holding in the Strait of Georgia but Late-run fish were also moving into the river. The pink run-size model continued to underestimate abundance because of the multi-modal distribution of daily pink abundances. At the request of the Panel, Staff explored alternative methods for estimating pink abundance through the southern approach, including: (1) Area 20 purse seine test fishery CPUE and (2) U.S. commercial fishery CPUE. Analyses using the U.S. fishery data suggested a larger pink run and possibly an underestimate of the expansion line used for the Area 20 test fishery, but the results were very uncertain. The Panel adopted the following updates to sockeye run sizes, based primarily on estimates of catch and escapement to date: 570,000 Early Summer (due to increased abundance of North Thompson), 1,550,000 Summer, 1,325,000 Lates (due to increased abundance of Birkenhead) and 1,000,000 Harrison. The Panel approved a reduced pink salmon run size of 16,000,000 fish, relative to the p50 forecast value of 17,495,000. Canada and the U.S. both had sufficient remaining balances in both sockeye and pink TAC to conduct fisheries. Although U.S. fisheries had caught more than a strict proportional share of Harrison sockeye, catch in remaining fisheries was expected to be minimal and potential stock group impacts within acceptable levels. The Panel therefore approved U.S. and Canadian fishery proposals in Panel waters.

September 11 – 17: Test fisheries in marine areas terminated this week. Increased sockeye catches at Whonnock indicated an influx into the river of fish that had been holding in the Strait of Georgia. These were predominantly Adams/Weaver but some Harrison, North Thompson, Summer and Birkenhead fish were also present. Pink run-size estimates using an adjusted Area 20 test fishery expansion line implied by U.S. fishery catches were several million fish greater than run-size estimates using the historical Area 20 test fishery expansion line. The Panel approved the following updates: 590,000 Early Summers (August 4 Area 20 timing) and 1,100,000 Harrison sockeye (August 8 Area 20 timing). The Panel adopted a pink salmon run size of 17,500,000 fish, which was the average of estimates from the Area 20 test fishery CPUE model and the adjusted CPUE model based on U.S. fishery catches. The Panel approved U.S. Treaty Indian fisheries that operated early in the week. The Panel also approved several Canadian fisheries, the majority of which did not allow sockeye retention.

September 29 (Final in-season meeting): The Panel adopted a Late-run abundance estimate of 1,544,000 sockeye, resulting in final in-season sockeye estimate of 5,077,000 Fraser sockeye as follows: 25,000 Early Stuart, 571,000 Early Summer, 1,556,000 Summer, 1,381,000 Harrison and

1,544,000 Late-run sockeye (322,000 Birkenhead and 1,222,000 Adams/Weaver) (Table 1). The Panel also adopted a final in-season run size of 18,300,000 Fraser pink salmon. Regulatory control was relinquished for all areas except the apex of U.S. Area 7A (Point Roberts).

Table 2. Number of days when Canadian commercial fisheries were open for directed harvest of Fraser River sockeye and pink salmon in 2011. Regulatory control of Canadian Panel Areas was relinquished by the Panel on September 17 for Area 20, October 1 for Areas 17 and 18 and October 15 for Area 29, in accordance with pre-season regulations (Appendix F).

Date	Panel Areas					Non-Panel Areas			
	20		29		18, 29	11-16			
	Purse		Purse		Troll	Purse		Troll	
	Seine	Gillnet	Seine	Gillnet		Seine	Gillnet	H	G
Jun.12-Jul.23									
Jul.24-Jul.30									
Jul.31-Aug.6									
Aug.7-Aug.13				1			5		
Aug.14-Aug.20				1	5	2		5	
Aug.21-Aug.27			1	1	7	7		7	
Aug.28-Sep.3			7	1	7	7		7	
Sep.4-Sep.10			7		7	7		7	
Sep.11-Sep.17			7		7	6		6	
Sep.18-Sep.24			6		6				
Sep.25-Oct.1									
Oct.2-Oct.8									
Total	0	0	28	4	39	29	5	32	0

Table 3. Number of days when major U.S. net fisheries in the Fraser River Panel Area were open for directed harvest of Fraser River sockeye and pink salmon in 2011. Regulatory control of U.S. Panel Areas was relinquished by the Panel on September 17 for Areas 4b, 5 and 6c, October 1 for portions of Area 7a and October 8 for the remaining portions of Area 7a, in accordance with pre-season regulations. Regulatory control of Areas 6 and 7 was relinquished on September 24 by in-season order (Appendix F).

Date	Treaty Indian		All Citizen		
	Areas	Areas	Areas 7 and 7A		
	4B, 5, 6C	6, 7, 7A	Purse Seine	Gillnet	Reefnet
Jun.12-Jul.23					
Jul.24-Jul.30	5				
Jul.31-Aug.6	7	3	1	1	1
Aug.7-Aug.13	7	1	1	1	2
Aug.14-Aug.20	5		1	1	1
Aug.21-Aug.27	7	4	1	1	4
Aug.28-Sep.3	7	3	1	1	7
Sep.4-Sep.10	6	4	2	2	5
Sep.11-Sep.17	1	1			
Sep.18-Sep.24					
Sep.25-Oct.1					
Oct.2-Oct.8					
Total	45	16	7	7	20

On October 8, 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 and the Commission Guidance to

the Panel. 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 Canadian and U.S. Panel Areas are contained in Tables 2 and 3, respectively. Although considered to be commercial fisheries, fishing effort in Canadian First Nations Economic Opportunity (Lower Fraser) and Commercial Communal (B.C. Interior) fisheries is not included in Table 2. 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 as fisheries managed by the Fraser River Panel.

IV. MANAGEMENT INFORMATION

To facilitate decision making, the Panel requires information about the abundance, timing, migration route and catch levels of Fraser sockeye (by management group) and pink salmon. Pre-season, these quantities are provided by DFO in the form of forecasts and by PSC Staff through analysis of historical data. Staff update these estimates in-season through various assessment programs (Appendix H). Stock monitoring programs collect information about abundance at various points along the migration route using test fisheries, hydroacoustic facilities (Mission) and observers (Hells Gate). The locations and schedule for these Staff and DFO programs are listed in Table 4. Stock identification programs collect and analyze biological samples (e.g., DNA, scales) from various fisheries, which is used to apportion the total abundance of sockeye into component stock groups and the total abundance of pink salmon into Fraser and non-Fraser components. Table 5 shows the sockeye stock resolution that was reported in 2011. These data are augmented with catch information from commercial, First Nations, recreational and other fisheries that are provided by the two countries.

Table 4. Panel-approved stock monitoring operations (test fishery, hydroacoustic and observer) conducted during the 2011 fishing season.

Area	Location	Gear	Dates	Operated by
Canadian Panel Areas				
20	Juan de Fuca Str.	Gillnet	July 11 - August 18	PSC
20	Juan de Fuca Str.	Purse Seine	July 23 - September 12	PSC
29-1 to 6	Str. of Georgia	Troll	August 16 - September 8	PSC
29-14	Fraser R. (Cottonwood)	Gillnet	July 12 - September 26	PSC
29-16	Fraser R. (Whonnock)	Gillnet	June 22 - September 30	PSC
29-16	Fraser R. (Mission)	Gillnet	August 11 - September 15	PSC
29-16	Fraser R. (Mission)	Hydroacoustic	July 12 - September 27	PSC
	Fraser R. (Hells Gate)	Observer	July 4 - September 30	PSC
Canadian non-Panel Areas				
12	Queen Charlotte Str. (Round Is.)	Gillnet	July 11 - August 15	DFO
12	Johnstone Str. (Naka Cr.)	Gillnet	July 18 - July 31	DFO
12	Johnstone Str. (Blinkhorn)	Purse Seine	July 23 - September 14	DFO
13	Lower Johnstone Str.	Purse Seine	July 25 - September 7	DFO
United States Panel Areas				
5	Juan de Fuca Str.	Gillnet	July 17 - July 25	PSC
7	San Juan Islands	Reefnet	July 23 - August 23	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 and Fraser River pink salmon. 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 and current year migration timing and river conditions. These data are compiled and analysed by Staff and the results provided to the Panel. The following sections provide a summary of these results.

Table 5. Individual stocks included in the Fraser River sockeye stock groups used in 2011. The Harrison stock was included in the Late run at the beginning of the season but later separated into its own group.

Stock Group	Component Stocks
Early Stuart	
Early Stuart	Early Stuart stocks
Early Summer	
Pitt	Pitt
Chilliwack	Chilliwack Lake, Dolly Varden Creek
Early Miscellaneous *	Nadina, Bowron, Gates, Nahatlatch, Taseko
North Thompson	Fennell, Raft, North Thompson
Seymour/Scotch	Scotch, Seymour, early Eagle, Cayenne, Upper Adams
Summer	
Chilko *	Chilko, south end Chilko Lake
Quesnel	{ Horsefly, McKinley, Mitchell, Roaring, Wasko, Blue Lead, Deception Point
Late Stuart/Stellako	Stellako, Tachie, Middle, Pinchi, Kuzkwa
Harrison	
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

* Taseko was included in the Summer-run Chilko group in-season, but with the Early Summer Early Miscellaneous group post-season.

A. Abundance

Final in-season estimates of run size adopted by the Panel totalled 5,077,000 Fraser sockeye (Table 1). The larger-than-forecasted abundance permitted substantial fishing opportunities in both countries. The post-season abundance estimate (5,130,000 fish, Tables 8 and 9) based on accounted catches, spawning ground enumerations and preliminary run-size adjustments is slightly higher than the end-of-season estimate (5,077,000 fish), but 61% higher than the median pre-season forecast (3,177,000 fish).

The final in-season estimate of Fraser River pink salmon abundance was 18,300,000 fish. Since 2003 when DFO discontinued spawning enumeration programs for Fraser pinks, final in-season run-size estimates based on test fishery data have been used as the post-season estimates. Ongoing research at Mission⁶, however, has produced hydroacoustic methods that provide reliable estimates of pink salmon passage during periods in September when high numbers of pink salmon migrate. Post-season estimates of pink salmon passage were consequently obtained for 2009 and 2011. The post-season run-size estimate of 20,649,000 fish was calculated by adding the estimated catch below Mission (6,947,000 fish) to the Mission passage estimate (13,702,000 fish, Table 7). This estimate is 18% larger than the median forecast.

⁶ 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.

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. Post-season estimates of migration timing in 2011 were 5 days later than expected for Early Stuart, 4 days later than expected for Early Summer, 4 days later than expected for Summer, as expected for Harrison and 3 days later than expected for Late-run stocks. Fraser pink salmon were 2 days later than expected (Figure 4).

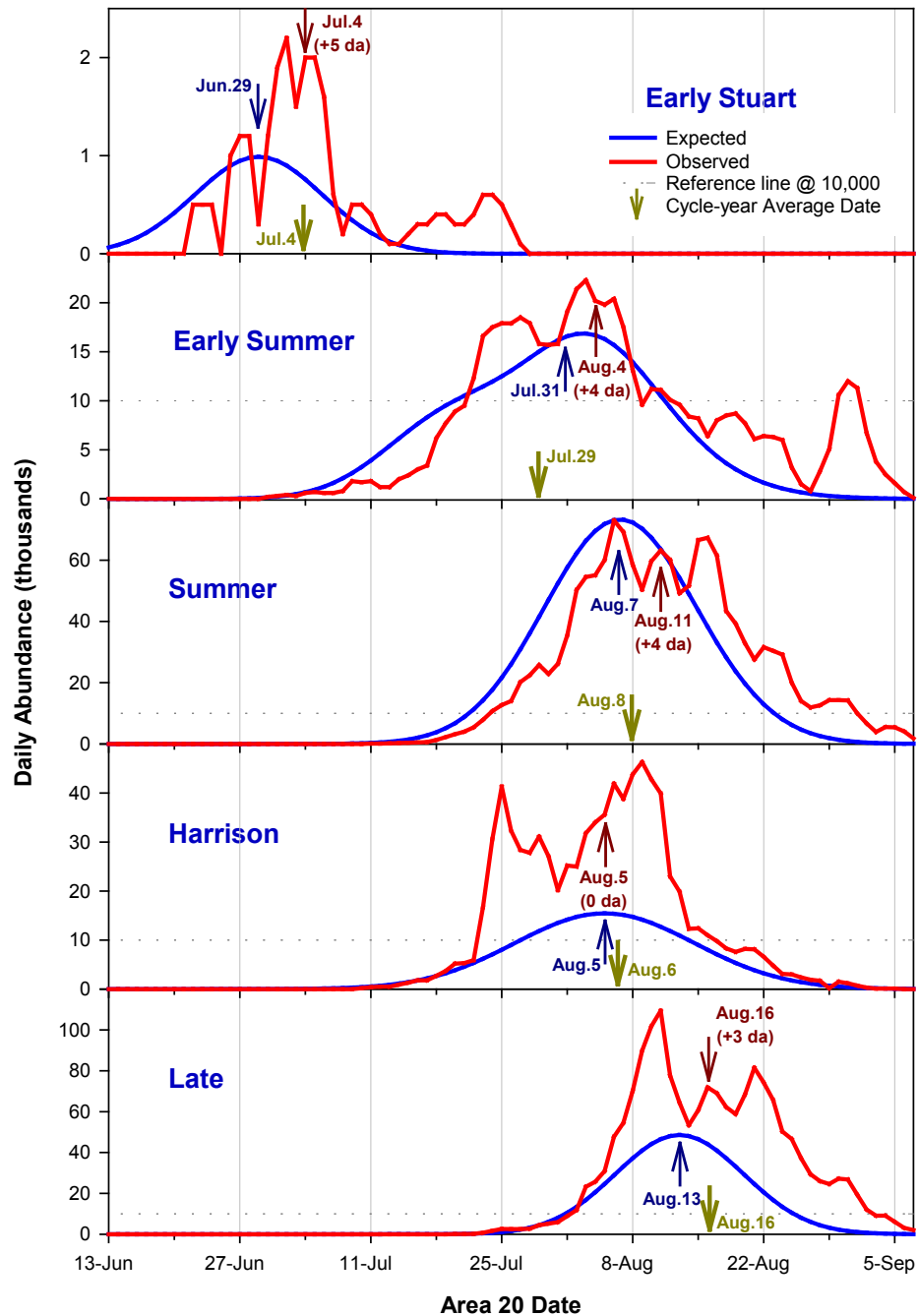


Figure 3. Pre-season projections and post-season reconstructions of daily Fraser River sockeye salmon abundance by management group in 2011 (Area 20 date), including the observed 50% dates and number of days difference with pre-season expectations. Cycle-year average dates are also shown.

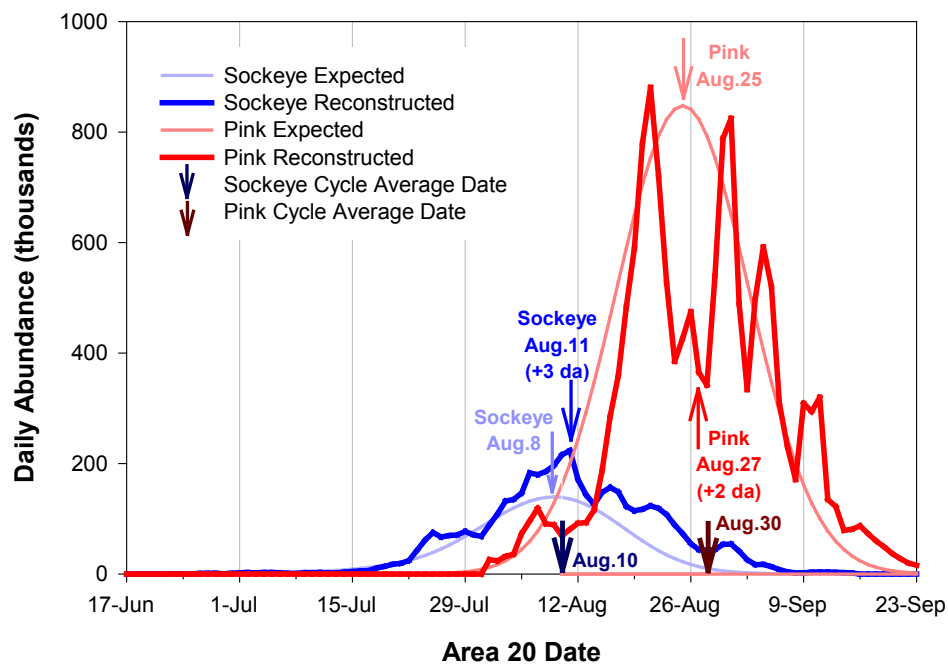


Figure 4. Pre-season projections and post-season reconstructions of daily Fraser River sockeye and pink salmon abundance in 2011 (Area 20 date), including the observed 50% dates and number of days difference with pre-season expectations. Cycle-year average dates are also shown.

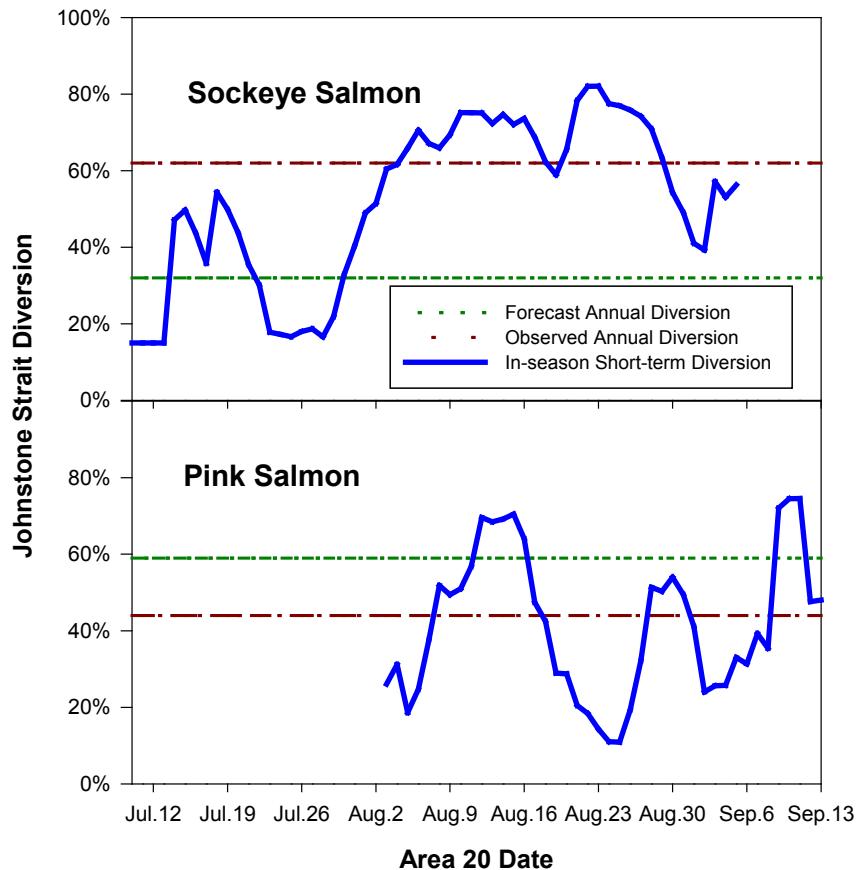


Figure 5. Pre-season forecasts of annual Johnstone Strait diversion rate for Fraser sockeye and pink salmon, compared to observed short-term and annual rates.

Johnstone Strait diversion rates in 2011 (Figure 5) were much higher than forecast for Fraser sockeye (62% compared to forecast of 32%) and lower than forecast for Fraser pink salmon (44% compared to forecast of 59%).

C. Management Adjustments and DBEs

Management adjustments or MAs are based on statistical models^{7,8,9,10} that consider the historical differences between projections of spawning escapement (i.e., Mission escapement minus catch upstream of Mission) and estimates of fish on the spawning grounds. For Early Stuart, Early Summer and Summer-run stocks, the models relate historical escapement differences (difference between estimates, or DBEs) to river conditions measured near Hells Gate in the Fraser River. When discharge levels or temperatures are above average, DBEs tend to be high. 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 relate to the date when half the run has migrated past Mission (i.e., 50% date), which captures the negative impact of the early migration behaviour on the migration success of these stocks that has been observed since the mid 1990s.

Pre-season MAs and DBEs are based on median cycle line values from historical datasets for each management group, or are forecasted from 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 river discharge and temperature. In contrast, post-season values are calculated independently of any environmental data as the difference between potential and spawning ground estimates of escapement. Potential spawning escapement (PSE) is defined as Mission passage minus in-river catch that occurs upstream of Mission between the hydroacoustic site and the spawning areas.

Table 6. Pre-season, in-season and post-season estimates of DBEs (differences between estimates) and pMAs (proportional management adjustments). Pre-season predictions are based on long-range forecasts of migration timing and of 31-day mean Fraser River temperature and discharge. In-season estimates reflect the final values adopted by the Panel for in-season management and are based on in-season forecasts of migration timing and 19-day mean river conditions. The 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.

Description	Early Stuart		Early Summer		Summer		Harrison		Late ¹ (excl. Harr.)	
	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA
Pre-season prediction	-55%	1.23	-17%	0.21	0%	0.00	na	na	-41%	0.69
In-season prediction	-80%	4.10	-28%	0.39	0%	0.00	-28%	0.38	-26%	0.35
Observed ²	-97%	27.75	-37%	0.60	45%	-0.31	-27%	0.36	-56%	1.29

1 Pre-season prediction was for all Lates combined (i.e., Harrison, Birkenhead, Shuswap/Portage and Weaver/Cultus). Harrison was separated from the Late-run during in-season management.

2 Derived from DFO's near-final spawning escapement estimates.

⁷ 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.

⁸ Macdonald, J.S., Patterson, D.A., Guthrie, I., Lapointe, M. 2008. Improvements to environmental management adjustment models: SEF final report.

⁹ 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.

¹⁰ 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.

A summary of the pre-season and in-season MA models adopted in 2011 are provided in the “Management Adjustment and DBE” section in Appendix H. Comparisons of %DBE (pMA) estimates for the pre-season, in-season and post-season periods are shown in Table 6. MA values adopted in-season were of a larger magnitude (more negative %DBEs, larger pMAs) than those forecasted pre-season for Early Stuart and Early Summer runs. The in-season pMA did not change for the Summer run (remained at zero), and the in-season pMA was smaller for the Late run compared to the pre-season estimate. Post-season observed values were greater than pre-season and in-season predictions for all management groups except Summers and Harrison. Of particular note, the observed DBE for Early Stuart was extremely severe (-97%).

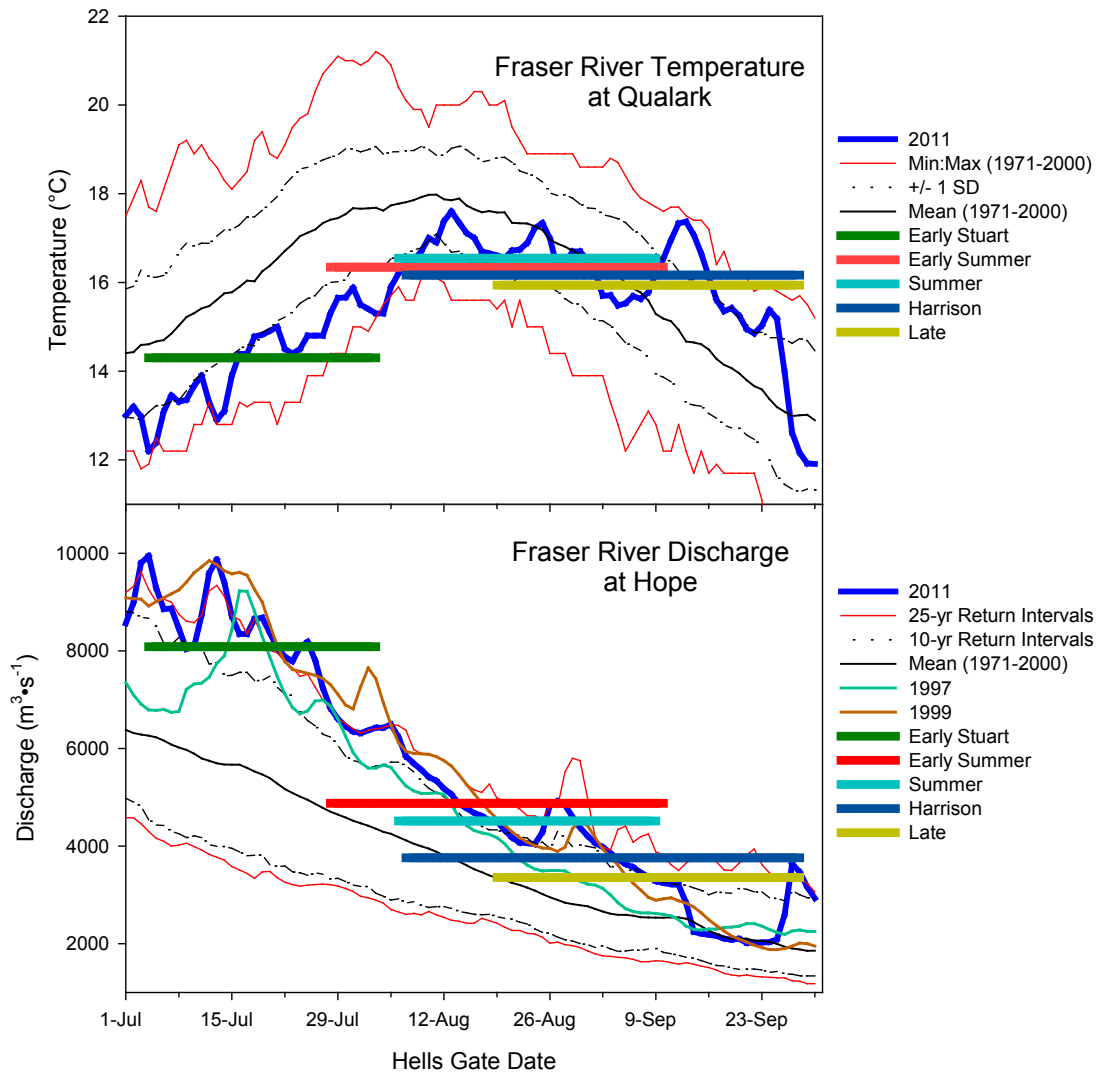


Figure 6. Fraser River temperature and discharge measured near Hope in 2011. Also shown are the mean temperature and discharge during the central 90% of the migration of each management group (excluding Pitt).

Due to cool, rainy spring conditions and above-average winter snowpack, discharge levels in the lower Fraser River remained well above the historical average for the duration of the summer (Figure 6). High discharge levels and cool air temperatures also resulted in below-average Fraser River water temperatures until late-August. Fraser River discharge levels (measured near Hope) that exceed $8,000 \text{ m}^3 \text{ s}^{-1}$ have been associated with migration delays and elevated levels of en route

mortality for Early Stuart sockeye¹¹. In 2011, discharge levels exceeded this threshold for the majority of a 31-day period during the Early Stuart migration. As a result, the upriver migration of Early Stuart sockeye appears to have been slower than usual. Late-run sockeye delayed in the Strait of Georgia longer than expected given migration behaviour in recent years, resulting in a smaller in-season %DBE than the pre-season expectation. However, despite the later than expected upstream migration the observed Late-run %DBE was more than twice as large as the in-season prediction.

D. Mission Passage

Estimates of Mission passage totalled 3,915,000 sockeye, consisting of 25,000 Early Stuart, 459,000 Early Summer, 1,043,000 Summer, 1,159,000 Harrison and 1,230,000 Late-run sockeye (Table 7). The post-season estimate of 13,702,000 pink salmon passage at Mission was generated from data obtained by near-shore DIDSONs (Dual-frequency IDentification SONar, Appendix H).

Table 7. Fraser River sockeye and pink salmon passage at Mission in 2011.

Management Group Stock Group	Mission Passage	
	fish	%
Early Stuart	24,700	1%
Early Summer	458,700	12%
Chilliwack	10,100	0%
Early Miscellaneous	133,200	3%
Seymour/Scotch	152,100	4%
North Thompson	139,700	4%
Pitt	23,500	1%
Summer	1,042,500	27%
Chilko	830,300	21%
Quesnel	87,000	2%
Late Stuart/Stellako	125,200	3%
Harrison	1,158,900	30%
Late	1,230,100	31%
Birkenhead	232,100	6%
Late Shuswap/Portage	447,800	11%
Weaver/Cultus	550,200	14%
Total Sockeye	3,914,900	100%
Pink Salmon	13,702,000	100%

¹¹ Macdonald, J.S. (Ed.) (2000). Mortality during the migration of Fraser River sockeye salmon (*Oncorhynchus nerka*): a study of the effect of ocean and river environmental conditions in 1997. Can. Tech. Rep. Fish. Aquat. Sci. 2315: 120 p.

V. RUN SIZE, CATCH AND ESCAPEMENT

Table 8 provides an overview of run size by management group for Fraser sockeye and pink salmon. Included are estimates of catches, spawning escapements and Run-size Adjustments (RSAs)¹². Table 9 provides similar information, but with more detail on individual sockeye stock groups. Figure 7 shows total sockeye abundance and spawning escapement by year, while Figures 8 (sockeye) and 11 (pink) show catch, escapement and exploitation rate by year for a historical perspective. Details of commercial catch distributions by area and gear in Canada and the U.S. are provided in Tables 10 and 11 for Fraser sockeye and in Tables 12 and 13 for Fraser pinks. Tables I1 (sockeye) and I2 (pink) in Appendix I show catch by user group, spawning escapement, RSA and total abundance over the last four cycle years, while Tables I3 (sockeye) and I4 (pink) in Appendix I show a geographic breakdown of Canadian First Nations catches. Sockeye salmon escapements since 1938 are summarized for total Fraser sockeye and by management group in Figure 10, and by stock for the last four cycle years in Table I5 in Appendix I. Table I6 in Appendix I reports production data for Fraser pink salmon since 1961.

A. Sockeye Salmon

The total abundance of sockeye salmon in 2011 was 5,130,000 fish (Tables 8 and 9), which is 61% larger than the median forecast of 3,177,000 fish and more than three times the brood year abundance of 1,510,000 fish in 2007. It was the largest return on the 2011 cycle since 1991 although similar in magnitude to cycle-year returns in 1995 - 2003 (Figure 7). This positive return was at least partly due to higher productivity in the ocean compared to most recent years.

All management groups returned at higher abundances than forecasted pre-season. The total return of Early Stuart sockeye was 21,000 adults (Tables 8 and 9). Although this return was larger than the forecast, it was among the lowest on record. Early Summer returns totalled 564,000 adult sockeye, 24% larger than the forecast. The largest Early Summer stock components were Early Miscellaneous (181,000 fish), North Thompson (165,000) and Seymour/Scotch (145,000 fish). The abundance of Summer-run sockeye was 2,023,000 adults, 35% larger than forecast. Most Summer-run fish were from the Chilko group. For the Harrison group, the total abundance of 1,393,000 adults was almost four times the pre-season forecast of 381,000 fish and the highest on record. The return of 1,123,000 adult non-Harrison Late-run sockeye was 34% larger than the pre-season forecast.

The total catch of 1,777,000 fish was about 35% of the run (Tables 8 and 9). This exploitation rate is within the range observed since the mid 1990s (Figure 8) following Canada's stock rebuilding strategy and conservation concerns for a number of Fraser sockeye stocks. Of the total catch, 1,439,000 fish were caught in Canada, 297,000 fish in the U.S. and 40,000 fish in test fisheries. Most of the Canadian catch was taken in First Nations FSC fisheries, followed by commercial (Table 10) and recreational fisheries. In Washington State roughly two thirds of the commercial catch (Table 11) was taken in Treaty Indian fisheries and one third in All Citizen fisheries. Approximately 18,000 Fraser sockeye were caught in Alaska.

DFO annually assesses the spawning ground abundance of sockeye populations in the Fraser watershed (Figure 9). In 2011, the near-final estimate of adult spawners (primarily age 4 and age 5 fish) totalled 2,580,000 fish, or 50% of the total run (Table 9). This escapement was almost three times larger than the brood year (2007) escapement of 887,000 adults and was the second largest escapement on the 2011 cycle on record.

¹² Run-size Adjustments (RSAs) 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. Staff work with the Fraser Technical Committee to provide recommendations to the Fraser Panel about how RSAs are assigned and corresponding best estimates of total return. PSC staff, Technical Committee members and DFO staff collaborate in a formal process for determining RSAs.

Table 8. Catch, escapement, run-size adjustment, abundance and exploitation rate for Fraser River sockeye (by management group) and pink salmon in 2011.

	Fraser Sockeye							Fraser Pinks	
	Early Stuart	Early Summer	Summer	Harrison	Late	Total	% of Run	Total	% of Run
CANADIAN CATCH	2,000	178,500	710,700	202,500	345,400	1,439,100	28%	4,931,000	24%
Commercial	10	35,300	192,400	82,600	138,900	449,200	9%	4,748,400	23%
Panel Area	0	17,500	89,000	33,600	20,700	160,800	3%	797,700	4%
Non-Panel Areas	10	14,800	86,900	15,200	90,400	207,200	4%	2,959,500	14%
First Nations EO & Demo	0	3,000	16,500	33,800	27,900	81,200	2%	991,300	5%
First Nations FSC	1,900	134,300	478,000	95,700	140,100	850,100	17%	59,000	0%
Marine	40	24,500	112,700	44,500	83,500	265,300	5%	21,600	0%
Fraser River	1,900	109,800	365,400	51,100	56,600	584,800	11%	37,400	0%
Non-commercial	70	8,900	40,200	24,200	66,400	139,800	3%	123,600	1%
Marine Recreational	50	800	3,800	3,100	9,500	17,300	0%	63,200	0%
Fraser Recreational	0	7,200	34,100	20,700	22,300	84,300	2%	55,300	0%
Charter	20	900	2,300	400	600	4,200	0%	1,200	0%
ESSR	0	0	0	0	33,900	33,900	1%	3,800	0%
UNITED STATES CATCH	10	16,400	115,800	75,000	90,000	297,200	6%	2,916,500	14%
Washington	10	15,200	104,400	73,100	86,000	278,800	5%	2,916,500	14%
Commercial	10	14,600	101,500	70,000	79,800	265,900	5%	2,901,500	14%
Treaty Indian	10	10,600	68,100	49,600	52,600	181,000	4%	1,403,800	7%
All Citizen	0	4,000	33,400	20,400	27,200	84,900	2%	1,497,700	7%
Non-commercial	0	500	2,900	3,100	6,300	12,900	0%	15,000	0%
Ceremonial	0	500	2,900	3,100	6,300	12,900	0%	13,800	0%
Recreational	0	0	0	0	0	0	0%	1,200	0%
Alaska	0	1,200	11,400	1,800	4,000	18,400	0%	0	0%
TEST FISHING CATCH	200	7,000	13,600	9,700	9,900	40,400	1%	13,100	0%
PSC (Panel Areas)	200	4,300	7,700	8,300	6,000	26,500	1%	11,900	0%
Canada	100	3,900	7,200	7,800	5,700	24,700	0%	9,300	0%
United States	20	500	500	600	200	1,700	0%	2,600	0%
Canada (non-Panel Areas)	30	2,700	5,900	1,400	4,000	14,000	0%	1,200	0%
TOTAL RUN	21,200	565,200	2,026,500	1,392,900	1,124,400	5,130,100	100%	20,649,000	100%
Total Catch in All Fisheries	2,200	201,900	840,100	287,200	445,300	1,776,800	35%	7,860,600	38%
Adult Spawning Escapement*	800	228,900	1,052,100	807,100	491,300	2,580,100	50%	12,788,400	62%
Jack Spawning Escapement	0	1,600	3,300	30	1,500	6,500	0%	0	0%
Run-Size Adjustment preliminary	18,200	132,800	131,000	298,500	186,300	766,800	15%	0	0%
Percentage of Total Run	100%	100%	100%	100%	100%	100%		100%	
Total Catch in All Fisheries	11%	36%	41%	21%	40%	35%		38%	
Spawning Escapement	4%	41%	52%	58%	44%	50%		62%	
Run-Size Adjustment	86%	23%	6%	21%	17%	15%		0%	

* Spawning escapement estimate for Cultus sockeye includes 253 individuals captured as brood stock.

Spawner abundances for most management groups exceeded those observed in the brood year (2007, Figure 10). The exception was Early Stuart with an escapement of only 800 fish (Table 9), 14% of the brood year escapement and the lowest since 1944 on any cycle. This very low escapement was due to a total return that was the 4th lowest on record, combined with an apparently very high rate of en route loss during their upstream migration because of an extended period of high discharge levels in the Fraser River. In a historical cycle-line context, spawning escapements in 2011 represent the: (1) lowest to the Early Stuart system on record; (2) highest Early Summer escapement since 1991; (3) similar Summer-run escapement as other cycle years

since 1991; (4) highest Harrison escapement on record; and (5) similar Late-run escapement as other cycle years since 1995 (Figure 10).

Table 9. Catch, escapement, run-size adjustment, abundance and exploitation rate for Fraser River sockeye (by stock group) and pink salmon in 2011.

Management Group Stock Group	Adult Spawning		Run-size Adjustment	Abundance			Portion of Run	Adult Exploitation Rate
	Catch	Escapement		Adult	Jack ¹	Total		
Fraser Sockeye Salmon								
Early Stuart	2,200	800	18,200	21,200	0	21,200	0%	10%
Early Summer-run	201,900	228,900	132,800	563,600	1,600	565,200	11%	36%
Chilliwack	600	4,500	1,500	6,500	10	6,600	0%	9%
Early Miscellaneous	64,400	77,900	39,000	181,300	1,600	182,900	4%	36%
Seymour/Scotch	68,200	66,300	10,500	145,000	0	145,000	3%	47%
North Thompson	58,800	24,200	81,900	164,900	0	164,900	3%	36%
Pitt	9,900	56,000	0	65,900	10	65,900	1%	15%
Summer-run	840,100	1,052,100	131,000	2,023,200	3,300	2,026,500	40%	42%
Chilko	676,400	916,600	101,800	1,694,900	2,600	1,697,500	33%	40%
Quesnel	58,200	46,200	18,300	122,700	0	122,700	2%	47%
Late Stuart/Stellako	105,400	89,300	10,800	205,500	700	206,200	4%	51%
Harrison	287,200	807,100	298,500	1,392,900	30	1,392,900	27%	21%
Late-run	445,300	491,300	186,300	1,122,900	1,500	1,124,400	22%	40%
Birkenhead	122,600	244,700	27,200	394,500	1,200	395,700	8%	31%
Late Shuswap/Portage	134,900	166,800	71,800	373,500	0	373,500	7%	36%
Weaver/Cultus	187,900	79,800 ²	87,300	354,900	300	355,200	7%	53%
Total	1,776,800	2,580,100	766,800	5,123,700	6,500	5,130,100	100%	35%
Portion of Total Run	35%	50%	15%	100%	0%	100%		
Fraser Pink Salmon								
Total	7,860,600	12,788,400	0	20,649,000	0	20,649,000	100%	38%
Portion of Total Run	38%	62%	-	100%		100%		

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

² Spawning escapement estimate of Cultus sockeye includes 253 individuals captured as brood stock.

The overall spawning success of adult female sockeye in the Fraser watershed was 81%. The effective female spawning population in 2011 totalled 1,165,000 fish, which was about 2½ times higher than the number of effective females in 2007. In a historical cycle-line context, the number of effective females spawners in 2011 was: (1) Early Stuart (233 fish, 81% spawning success) - only 10% of the brood year abundance and lowest since 1940; (2) Early Summer (105,000 fish, 82% spawning success) - 60% larger than in the brood year and within the range of recent cycle years; (3) Summer (502,000 fish, 80% spawning success) - more than twice as large as the brood year abundance and similar to recent cycle years; (4) Harrison (388,000 fish, 91% spawning success) - almost seven times larger than in the brood year and the second highest on record (only 2010 was higher); and (5) Late (170,000 fish, 66% spawning success) - 61% larger than in the brood year but less than most recent cycle years.

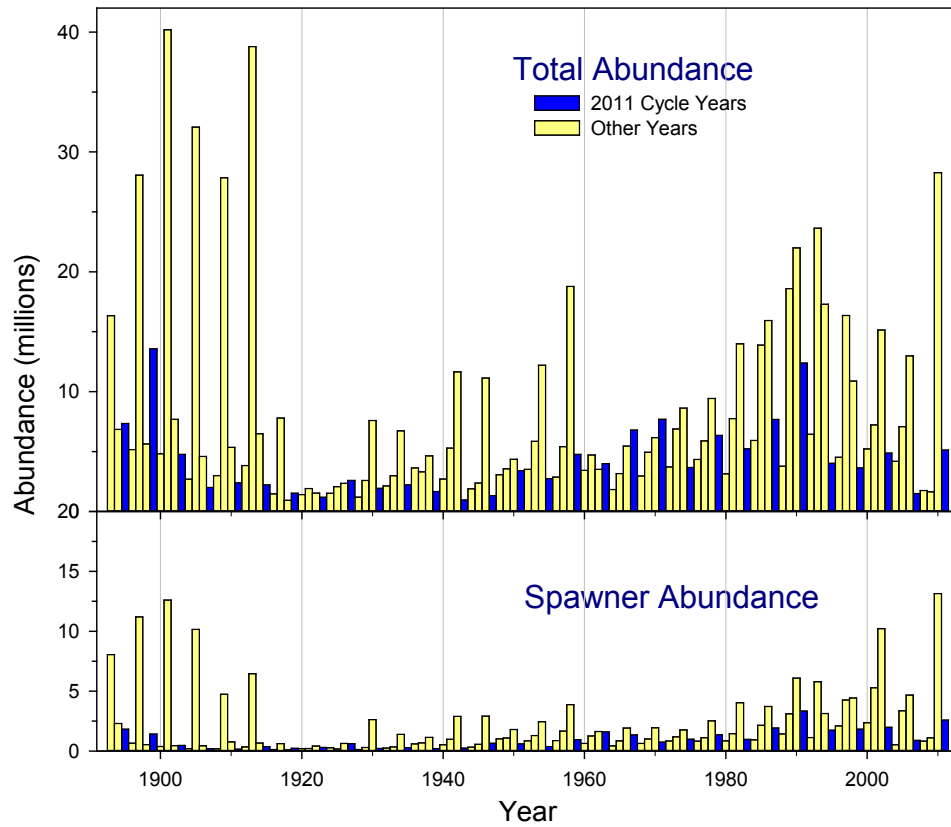


Figure 7. Total abundance (top) and adult spawner abundance (bottom) of Fraser River sockeye salmon in 1893-2011. Returns on the 2011 cycle are emphasized.

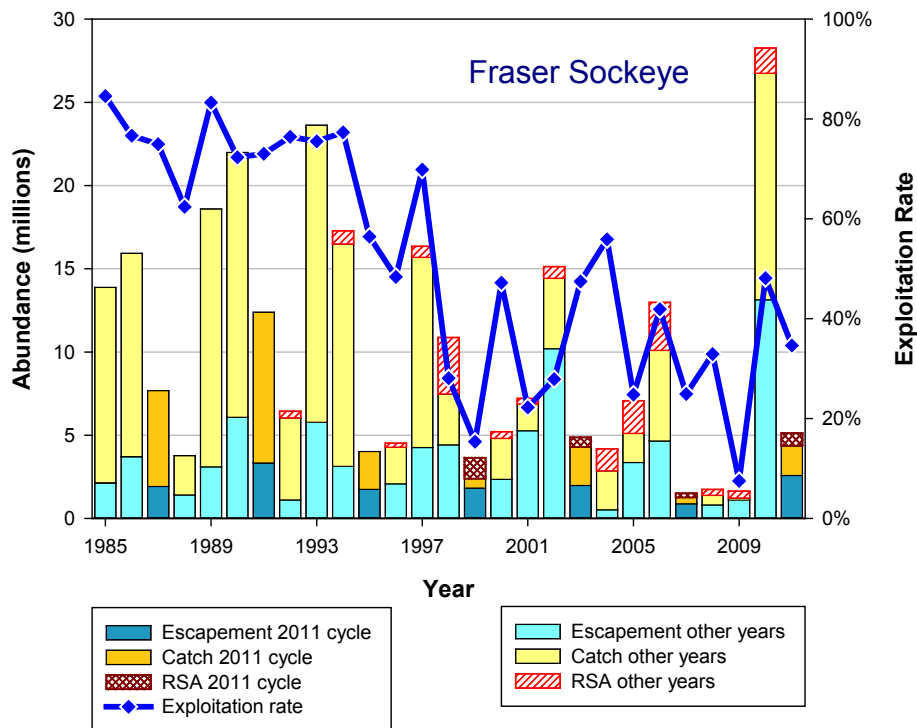


Figure 8. Total catch, escapement, run-size adjustment, abundance and exploitation rate for Fraser River sockeye salmon in 1985-2011, with returns on the 2011 cycle emphasized.

The preliminary RSA estimate was 767,000 fish, or 15% of the total return. As a percentage of run size for each management group, Early Stuart had the largest RSA (86%) and the Summer-run group the lowest (6%), with the remaining groups in the 17-23% range (Tables 8 and 9).

Table 10. Canadian commercial catches of Fraser River sockeye salmon by gear type, license designation and statistical area in 2011. Grey areas indicate fishery areas that are not part of the license area designation.

Fishery Areas	Purse Seine		Gillnet			Troll			Total
	Area A	Area B	Area C	Area D	Area E	Area F	Area G	Area H	
Commercial	0	97,800	0	98,700	158,600	0	0	13,000	368,000
Panel Areas	0	800	0	0	158,600	0	0	1,400	160,800
20		0			0		0		0
17, 18, 29		800			158,600			1,400	160,800
121-124 *		0			0		0		0
Non-Panel Areas	0	97,000	0	98,700	0	0	0	11,600	207,200
1-10	0		0			0			0
11-16		97,000		98,700	0		0	11,600	207,200
124-127 *		0			0		0		0
First Nations Economic Opportunity and Demo Fisheries									81,200
Total Catch									449,200

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

Table 11. U.S. commercial catches of Fraser River sockeye salmon by user group, gear type and statistical area in 2011.

Areas	Purse				Total
	Troll	Seine	Gillnet	Reefnet	
Panel Area (Washington)	0	189,900	72,000	4,000	265,900
Treaty Indian *	0	129,600	51,400	0	181,000
4B, 5 and 6C	0	0	21,900	0	21,900
6 and 7	0	110,500	20,000	0	130,500
7A	0	19,100	9,500	0	28,600
All Citizen **	0	60,200	20,700	4,000	84,900
7	0	50,300	13,400	4,000	67,600
7A	0	10,000	7,300	0	17,300
Alaska (District 104) Catch					18,400
United States Total					284,300

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

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

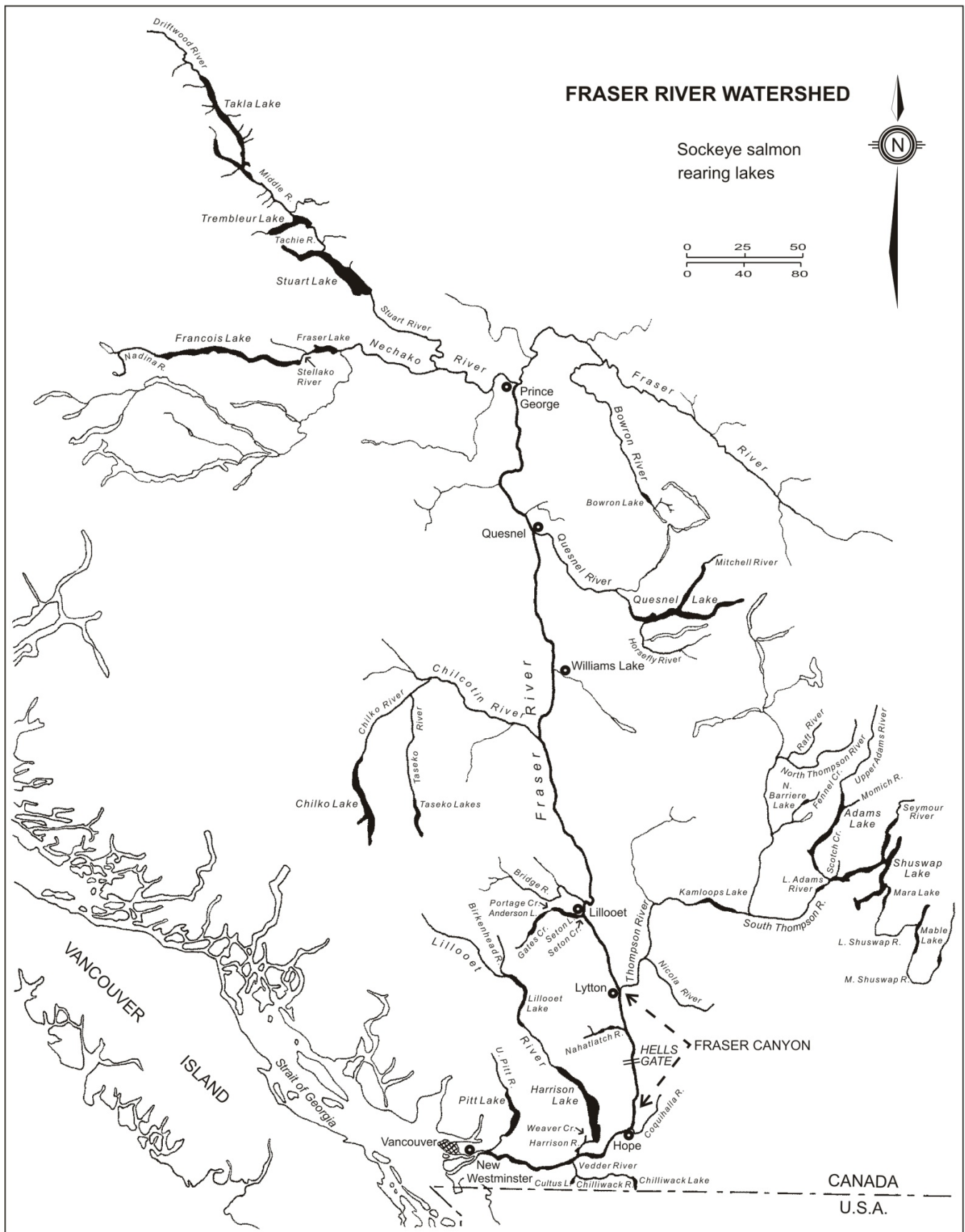


Figure 9. Sockeye salmon spawning areas in the Fraser River watershed.

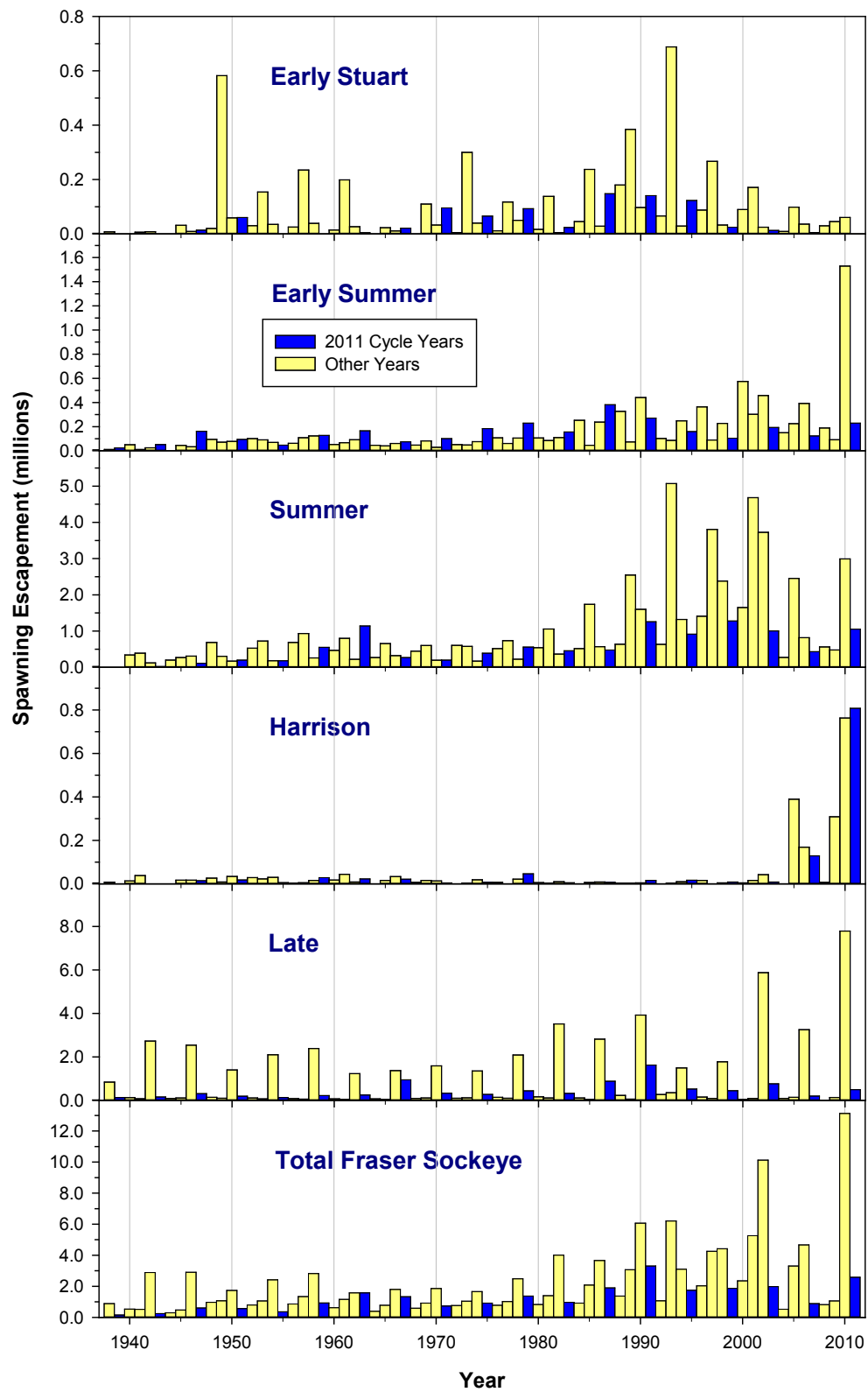


Figure 10. Annual adult spawning escapement of Fraser River sockeye salmon for each management group and for total sockeye in 1938-2011, with escapements on the 2011 cycle emphasized.

B. Pink Salmon

The in-season run-size estimate was 18,300,000 fish, which is very close to the median pre-season forecast of 17,495,000 fish (Table 1). The post-season estimate of 20,649,000 fish was 18% higher than the forecast (Tables 8 and 9). Unlike recent years, the post-season estimate of Fraser pink abundance was an accounting-based estimate. Hydroacoustic research has provided Staff with the ability to obtain reliable estimates of pink salmon passage at Mission. Summing this passage estimate (13,702,000) with the catch below Mission (6,947,000) provided the post-season estimate of total abundance noted above.

Returns of Fraser pink salmon (Figure 11) have shown large variation in recent years, with the lowest return since 1965 occurring in 1999 (3,586,000 fish), followed four years later by the highest return (26,000,000 fish) since records began in 1959. The 2011 return was substantially higher than average and the 4th largest since 1959.

The exploitation rate of Fraser River pink salmon in 2011 was 38%, substantially higher than the low exploitation rates (5-10%) observed in 1999-2007 and similar to rates observed in the early 1990s, but still much lower than the 1959-1989 average exploitation rate of 68% (Figure 11). The low exploitation rates observed in the 1999-2007 period were partly due to conservation concerns for Late-run sockeye and Interior Fraser coho that co-migrate with pink salmon, but also reflect the impact of low consumer demand and market value for pink salmon. These low harvest levels resulted in substantial spawning escapements of Fraser pinks in recent years. The exploitation rates in 2009 (23%) and 2011 reflect an increased effort applied to pink-directed fisheries. This increase was primarily due to limited opportunities for sockeye-directed fisheries and increased interest in pink salmon, combined with enough separation between Fraser sockeye and pink migrations to make pink-directed fisheries feasible while respecting sockeye conservation objectives. The fact that some fisheries released sockeye also enabled greater access to pink salmon harvest than was possible in recent past years. The result was the largest pink catch since 1991 and the 5th largest spawning escapement on record.

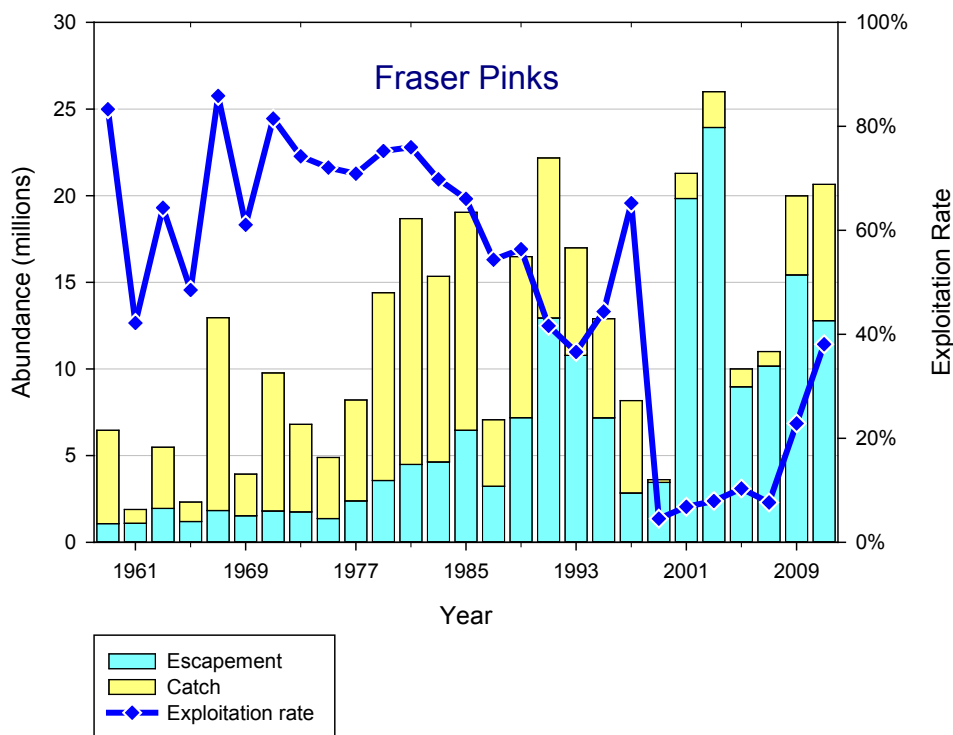


Figure 11. Total catch, escapement, abundance and exploitation rate for Fraser River pink salmon in 1959-2011.

Of the total Fraser River pink salmon catch, 4,931,000 fish were caught in Canada, 2,917,000 in the U.S. and 13,000 in test fisheries (Table 8). The Canadian catch included a commercial catch of 4,748,000 fish (Table 12), a First Nations FSC catch of 59,000 and a recreational catch of 119,000. The U.S. catch included a commercial catch of 2,901,000 fish that was split nearly evenly between Treaty Indian and All Citizen fishers (Table 13), a ceremonial catch of 14,000 fish and a recreational catch of 1,000 fish.

Table 12. Canadian commercial catches of Fraser River pink salmon by gear type, license designation and statistical area in 2011. Grey areas indicate fishery areas that are not part of the license area designation.

Fishery Areas	Purse Seine		Gillnet			Troll			Total
	Area A	Area B	Area C	Area D	Area E	Area F	Area G	Area H	
Commercial	0	3,633,100	0	10,400	80,200	0	0	33,500	3,757,200
Panel Areas	0	716,200	0	0	80,200	0	0	1,300	797,700
20		0			0		0		0
17, 18, 29		716,200			80,200			1,300	797,700
121-124 *		0			0		0		0
Non-Panel Areas	0	2,916,900	0	10,400	0	0	0	32,200	2,959,500
1-10	0		0			0			0
11-16		2,916,900		10,400	0		0	32,200	2,959,500
124-127 *		0			0		0		0
First Nations Economic Opportunity and Demo Fisheries									991,300
Total Catch									4,748,500

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

Table 13. U.S. commercial catches of Fraser River pink salmon by user group, gear type and statistical area in 2011.

Areas	Troll	Purse			Total
		Seine	Gillnet	Reefnet	
Panel Area (Washington)	0	2,688,000	44,000	170,000	2,901,000
Treaty Indian *	0	1,366,000	38,000	0	1,404,000
4B, 5 and 6C	0	0	10,000	0	10,000
6 and 7	0	952,000	10,000	0	962,000
7A	0	414,000	18,000	0	432,000
Non-Indian **	0	1,321,000	7,000	170,000	1,498,000
7	0	563,000	5,000	170,000	737,000
7A	0	758,000	2,000	0	760,000
Non-Panel Area					0
United States Total					2,901,000

* 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 that are set by Canada; (2) achieve targets for international sharing of the TAC as defined in the Treaty; and (3) achieve domestic catch allocation goals within each country. In addition, the Panel must consider conservation concerns for other stocks and species of salmon when planning and conducting fisheries. 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 to First Nations FSC (Food, Social and Ceremonial) harvest within Canada's allocation.

A. Escapement

The Panel's first task is to achieve spawning escapement targets as specified by Canada. Spawning escapement targets were determined by applying Canada's spawning escapement plan to abundance estimates for each management group. Mid-way through the season the Harrison stock was removed from the Late-run management group and placed in its own management group (August 19, Table 1). This was done because in-season estimates of Harrison abundance greatly exceeded pre-season expectations, and because Harrison sockeye populations have increased in recent years despite earlier upstream migration than other Late-run stocks. Canada's pre-season escapement plan for the Late-run group (when it included Harrison) was used to calculate a TAM rule (Total Allowable Mortality as a percentage of the total return) that was applied to the revised groups to obtain in-season and post-season escapement targets.

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).

Table 14. Comparison of in-season targets and in-season estimates of potential spawning escapement (PSE) for adult Fraser River sockeye salmon in 2011.

Management Group	Final	Potential Spawning Escapement (PSE)					
	In-season	Spawning Escapement Target	Management Adjustment *	In-season	In-season	Difference	
	Abundance Estimate			PSE ** Target	PSE *** Estimate		
Adult sockeye	5,077,000	2,045,800	617,700	2,561,000	3,453,000	892,000	35%
Early Stuart	25,000	25,000	102,500	25,000	23,000	-2,000	-8%
Early Summer	571,000	228,400	89,100	317,500	376,000	58,500	18%
Summer	1,556,000	622,400	0	622,400	771,000	148,600	24%
Harrison	1,381,000	552,000	209,800	761,800	1,116,000	354,200	46%
Late	1,544,000	618,000	216,300	834,300	1,167,000	332,700	40%

* Adjustment of spawning escapement targets to achieve spawning escapement goals. If the spawning escapement target + MA exceeds the total abundance, then the target equals the total abundance.

** Spawning escapement target + Management Adjustment.

*** Mission passage minus all catch above Mission.

Based on final in-season PSE estimates, in-season PSE targets were nearly achieved for Early Stuart (8% under), and exceeded by 18-46% for the remaining management groups (Table 14). One reason for the targets being generally exceeded was that as the season progressed the TAC and available harvest increased but fishery harvests did not (Figure 12), due to the combined effect

of mixed-stock constraints and of migration patterns that meant the opportunity to harvest Fraser sockeye in areas and gears with remaining harvest allocations had elapsed.

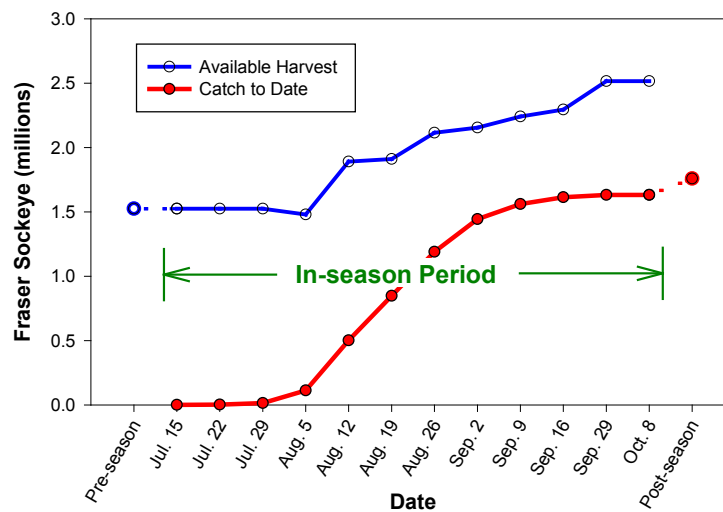


Figure 12. Available harvest of Fraser sockeye compared to catch to date in all fisheries in 2011. The available harvest is calculated as run size minus spawning escapement target and management adjustment, and represents fish that are available for catch in all commercial, recreational, First Nations and test fisheries.

In terms of the achievement of post-season objectives, total spawning escapements of Fraser sockeye (25% over) and pink salmon (113% over) exceeded the post-season targets (Table 15). The spawning escapement of Early Stuart sockeye was severely below the target (96% below), while escapements for the remaining sockeye management groups exceeded the targets by 1-45% (Table 15). For Early Stuart, the post-season spawning escapement target equaled the entire run size, thus any catch or en route loss would result in an escapement below the target level. The shortfall of 20,400 fish on the Early Stuart spawning grounds is explained by the observed DBE of -97% (Table 6) and a catch of about 2,000 fish (Tables 8 and 9).

Table 15. Comparison of post-season spawning escapement targets and escapement estimates for adult Fraser River sockeye and pink salmon in 2011. 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 post-season run-size estimate.

Management Group	Post-season Run-size Estimate	Spawning Escapement			
		Post-season Target	Adult Estimate	Difference	
				Fish	%
Sockeye salmon	5,130,100	2,064,800	2,580,100	515,400	25%
Early Stuart	21,200	21,200	800	-20,400	-96%
Early Summer	565,200	226,100	228,900	2,800	1%
Summer	2,026,500	810,600	1,052,100	241,500	30%
Harrison	1,392,900	557,200	807,100	249,900	45%
Late	1,124,400	449,700	491,300 *	41,600	9%
Pink salmon	20,649,000	6,000,000	12,788,400	6,788,400	113%

* Late-run escapement estimate include 253 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 1 the February 17, 2011 Commission Guidance (Appendix C), 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 8). The test fishing catch deduction is the post-season estimate, however.

With the total in-season abundance estimate of 5,077,000 Fraser sockeye, minus deductions for spawning escapement, MA, test fishing catch and AFE, the TAC in 2011 was 2,078,000 sockeye (Table 16). The Washington share of the TAC (16.5%) was 343,000 fish and their catch was 279,000 fish, leaving a shortfall of 64,000 Fraser sockeye. Canada's catch of 1,405,000 Fraser sockeye (excluding the 34,000 ESSR catch) was 730,000 fish less than the total of their allowable harvest of the TAC plus the AFE. A detailed version of the TAC calculations by management group is presented in Appendix I, Table I7.

Table 16. Total allowable catch (TAC) and achievement of international catch shares for Fraser River sockeye and pink salmon in 2011. 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 8), in accordance with Annex IV of the Treaty and the February 17, 2011 Commission Guidance.

		<u>Sockeye</u>		<u>Pink</u>	
TOTAL ALLOWABLE CATCH					
In-season Total Run Size		5,077,000		18,300,000	
Deductions		3,103,900		6,013,100	
In-season Spawning Escapement Target		2,045,800		6,000,000	
In-season Management Adjustment		617,600		n/a	
Aboriginal Fishery Exemption (AFE)		400,000		n/a	
Post-season Test Fishing Catch		40,400		13,100	
Total Allowable Catch	1, 2	2,077,800		12,286,900	
UNITED STATES					
Washington Share		342,800		3,157,700	
Washington Share of TAC	1, 3	342,800	16.5%	3,157,700	25.7%
Payback		0		0	
Washington Catch		278,800		2,916,500	
Deviation		64,000		241,300	
In-season Alaska Catch Estimate		0		0	
CANADA					
Canadian Portion of TAC + U.S. Payback + AFE		2,134,900		9,129,100	
Canadian Catch excluding ESSR Catch		1,405,200		4,931,000	
Deviation		729,700		4,198,100	

- 1 TAC and Washington sockeye share according to Annex IV of the Pacific Salmon Treaty and Feb. 17, 2011, Commission Guidance.
- 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 Table 7 in Appendix I.
- 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).

The TAC for Fraser pink salmon was 12,287,000 fish, with a U.S. share of 3,158,000 fish (25.7%) and Canadian allowable harvest of 9,129,000 fish (Table 16). Both countries caught less than their respective amounts, with the U.S. catching 241,000 fish under their share and Canada 4,198,000 fish under.

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. Thus, achievement of Canadian domestic allocation goals requires coordination between Panel and non-Panel regulatory actions.

With respect to domestic allocations of Fraser sockeye salmon, Treaty Indian fishers in the U.S. caught 38,000 fish less than their share of the TAC and All Citizen fishers caught 26,000 fish less than their share (Table 17). Regarding Fraser pink salmon, Treaty Indian fishers caught 161,000 fish less than their share of the TAC and All Citizen fishers caught 80,000 fish less (Table 18).

Table 17. Achievement of domestic catch goals in Washington for Fraser River sockeye salmon in 2011.

User Category	Actual Catch		Share of TAC		Deviation
	Fish	%	Fish	%	
Washington Total	278,800	100.0%	342,800	100.0%	-64,000
Treaty Indian *	193,900	69.5%	232,100	67.7%	-38,200
All Citizen **	84,900	30.5%	110,700	32.3%	-25,800

* Treaty Indian catch includes commercial and ceremonial catches.

** All Citizen catch includes commercial and recreational catches.

Table 18. Achievement of domestic catch goals in Washington for Fraser River pink salmon in 2011.

User Category	Actual Catch		Share of TAC		Deviation
	Fish	%	Fish	%	
Washington Total	2,916,500	100.0%	3,157,700	100.0%	-241,200
Treaty Indian *	1,417,600	48.6%	1,578,900	50.0%	-161,300
All Citizen **	1,498,900	51.4%	1,578,900	50.0%	-80,000

* 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. By-catches of non-Fraser sockeye and pink salmon in commercial net fisheries regulated by the Fraser River Panel totalled 470 sockeye and 748,000 pink salmon in 2011 (Table 19). Catches of other Fraser and non-Fraser salmon species included 11,400 chinook, 4,000 coho, 500 chum and 10 steelhead.

Table 19. Catches of non-Fraser sockeye and pink salmon and catches of other salmon species in commercial fisheries regulated by the Fraser River Panel in 2011.

Area and Gear	Non-Fraser		Fraser and Non-Fraser			
	Sockeye	Pink	Chinook	Coho	Chum	Steelhead
United States *	460	748,470	6,010	3,680	190	10
Areas 4B, 5 and 6C Net	120	12,610	320	1,260	30	10
Areas 6, 7 and 7A Net	340	735,860	5,680	2,420	160	0
Canada **	10	0	5,380	290	320	0
Area 20 Net	0	0	0	0	0	0
Area 29 Net	10	0	5,380	290	320	0
Total	470	748,470	11,390	3,970	510	10

* 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.

VII. ALLOCATION STATUS

25. There were no paybacks of Fraser sockeye or pink salmon to carry forward to the 2012 fishing season (Table 20).

Table 20. Allocation status for Fraser River sockeye and pink salmon in 2007-2011.
After 2011, no paybacks were due for either Fraser sockeye or pink salmon.

		Fraser Sockeye				
		2007	2008	2009	2010	2011
TOTAL ALLOWABLE CATCH						
Total Run Size		1,428,000	1,715,000	1,370,000	34,546,000	5,077,000
Escapement and other deductions		1,428,000	1,369,700	1,370,000	18,769,100	2,999,200
Total Allowable Catch:		0	345,300	0	15,776,900	2,077,800
UNITED STATES						
Washington Catch		3,400	49,400	4,300	1,959,600	278,800
Washington Share (exclds payback) *		0	57,000	0	2,603,200	342,800
Deviation:		3,400	-7,600	4,300	-643,600	-64,000
Cumulative Allocation Status:		3,400	0 **	4,300	0 **	0 **
CANADA						
Catch		197,000	481,100	73,800	11,558,700	1,405,200
Allowable Catch + Aboriginal Exemption		197,000	688,300	146,800	13,573,700	2,135,000
Deviation:		0	-207,200	-73,000	-2,015,000	-729,800

		Fraser Pink		
		2007	2009	2011
TOTAL ALLOWABLE CATCH				
Total Run Size		11,000,000	19,500,000	18,300,000
Escapement and other deductions		6,000,000	6,021,800	6,013,100
Total Allowable Catch:		5,000,000	13,478,200	12,286,900
UNITED STATES				
Washington Catch		395,100	2,815,600	2,916,500
Washington Share *		1,285,000	3,463,900	3,157,700
Deviation:		-889,900	-648,300	-241,200
Cumulative Allocation Status:		0 **	0 **	0 **
CANADA				
Catch		406,100	1,714,500	4,931,000
Allowable Catch		3,715,000	10,014,300	9,129,200
Deviation:		-3,308,900	-8,299,800	-4,198,200

- * Washington share of the TAC according to Annex IV of the Pacific Salmon Treaty:
2007: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks.
The U.S. catch of 3,400 Fraser sockeye were by-catch in pink-salmon directed fisheries and were landed as ceremonial catch.
2008: Shall not exceed 16.5% for Fraser sockeye. By Panel agreement (Sep. 25, 2008), no paybacks resulted from the 2008 season.
2009: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks.
2010: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks.
2011: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks.
- ** By Panel agreement, no paybacks are to be carried forward.

VIII. APPENDICES

APPENDIX A: GLOSSARY OF TERMS AND ABBREVIATIONS

Bayesian inference: Statistical inference which allows pre-season forecasts of run size, diversion rate, and migration timing to be updated with in-season observations. Uncertainty in the estimates decreases as more in-season data become available. The name "Bayesian" comes from the frequent use of Bayes' theorem in the inference process.

Commercial Communal (CC) fishery: Commercial First Nations fishery issued under a communal licence.

Cycle line: A series of years associated with a cohort of Fraser sockeye assuming spawners are 4 year old. A cycle line of a particular year includes every 4th year starting from that year (e.g., 2003, 2007, 2011).

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

Difference between estimates (DBE): Difference between estimates of potential spawning escapement (PSE) and spawning escapement (SE) ($DBE = PSE - SE$, $\%DBE = 100 * DBE / PSE$). 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. DBEs may be represented as a number of fish or a percentage of the potential spawning escapement, and are related to pMAs through the formula: $pDBE = (1 / (1 + pMA)) - 1$. The proportional DBE is usually shown as a percentage, such that $\%DBE = 100 * pDBE$.

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 established in the early 1990's.

ESSR: Terminal harvest of salmon that are "Excess Salmon to Spawning Requirements" (e.g., Weaver Creek sockeye).

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

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

Management Adjustment (MA): Additional fish added to an escapement target for the purpose of increasing the likelihood of achieving the escapement target. Such MAs are calculated using MA models, which use estimates of migration timing and river conditions to predict proportional adjustments (pMA) to spawning escapement targets. 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. DBEs are related to pMAs through the formula: $pMA = ((1/(1+pDBE)) - 1)$, where pDBE is the %DBE represented as a proportion.

Management group or Run-timing group: Aggregates of sockeye salmon stocks that are used in Fraser Panel management, i.e., Early Stuart, Early Summer, Summer, Harrison 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, as estimated by the date when 50% of 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 the reconstructed run to Mission (Mission escapements plus catches seaward of 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 supplemented by expanded CPUE estimates derived 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 2011 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.

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): Additions to the total return 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, spawning grounds that did not have enumeration programs.

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 enumeration programs conducted on the spawning grounds, or projected from other data when such programs are not conducted in all areas (e.g., Quesnel spawners omitted in 2002). Such escapement numbers do not include losses from pre-spawn mortality on the spawning grounds, however, pre-spawn mortality 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	LGL: A biological consulting company
BC: Province of British Columbia	MA: Management Adjustment
DBE: Difference between estimates	MLP: Mandatory Landing Program
CPUE: Catch per Unit of Effort	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
FSC: “Food, social and ceremonial”	TAC: Total Allowable Catch
	TAM: Total Allowable Mortality
	WDFW: Washington Department of Fish and Wildlife

APPENDIX B: 2011 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 2011. (Provided to the Panel by Fisheries and Oceans Canada).

Run timing group	Mean Run Size		Probability that Return will be at/or Below Specified Run Size ^a				
	all cycles ^c	2011 cycle ^d	10%	25%	50%	75%	90%
Stocks							
Early Stuart	311,000	172,000	6,000	11,000	17,000	27,000	42,000
Early Summer	510,000	497,000	153,000	257,000	453,000	894,000	1,558,000
<i>(total excluding miscellaneous)</i>	<i>510,000</i>	<i>497,000</i>	<i>107,000</i>	<i>181,000</i>	<i>332,000</i>	<i>648,000</i>	<i>1,232,000</i>
Bowron	39,000	79,000	2,000	2,000	5,000	12,000	22,000
Fennell	25,000	33,000	14,000	21,000	35,000	60,000	93,000
Gates	53,000	24,000	2,000	4,000	8,000	16,000	30,000
Nadina	80,000	87,000	4,000	7,000	12,000	21,000	37,000
Pitt	72,000	71,000	32,000	51,000	82,000	140,000	236,000
Raft	32,000	21,000	29,000	44,000	68,000	108,000	171,000
Scotch	78,000	19,000	14,000	32,000	80,000	201,000	465,000
Seymour	131,000	163,000	10,000	20,000	42,000	90,000	178,000
Misc ^e	--	--	11,000	23,000	40,000	54,000	77,000
Misc ^f	--	--	3,000	5,000	7,000	17,000	23,000
Misc ^g	--	--	27,000	40,000	57,000	138,000	180,000
Misc ^h	--	--	2,000	3,000	6,000	13,000	16,000
Misc ⁱ	--	--	3,000	5,000	11,000	24,000	30,000
Summer	3,730,000	2,389,000	590,000	903,000	1,500,000	2,657,000	4,835,000
Chilko ^j	1,350,000	1,556,000	513,000	749,000	1,141,000	1,740,000	2,548,000
Late Stuart	560,000	86,000	5,000	14,000	41,000	123,000	331,000
Quesnel	1,358,000	153,000	50,000	99,000	239,000	639,000	1,673,000
Stellako	462,000	594,000	22,000	41,000	79,000	155,000	283,000
Late	3,020,000	2,196,000	257,000	516,000	1,207,000	3,288,000	5,648,000
<i>(total excluding miscellaneous)</i>	<i>3,020,000</i>	<i>2,196,000</i>	<i>254,000</i>	<i>502,000</i>	<i>1,188,000</i>	<i>3,261,000</i>	<i>5,612,000</i>
Cultus ^{j&k}	39,000	86,000	4,000	6,000	9,000	13,000	17,000
Harrison ^l	60,000	71,000	37,000	96,000	372,000	1,656,000	2,630,000
Late Shuswap	2,152,000	1,427,000	60,000	152,000	355,000	780,000	1,555,000
Portage	40,000	27,000	4,000	9,000	21,000	47,000	98,000
Weaver	363,000	209,000	90,000	143,000	253,000	444,000	761,000
Birkenhead	366,000	376,000	59,000	96,000	178,000	321,000	551,000
Misc. non-Shuswap ^m	--	--	3,000	14,000	19,000	27,000	36,000
TOTAL	-	-	1,006,000	1,687,000	3,177,000	6,866,000	12,083,000
<i>(TOTAL excluding miscellaneous)</i>	<i>(7,571,000)</i>	<i>(5,254,000)</i>	<i>(957,000)</i>	<i>(1,597,000)</i>	<i>(3,037,000)</i>	<i>(6,593,000)</i>	<i>(11,721,000)</i>
Pink Salmon	11,800,000	11,800,000	9,156,000	12,648,000	17,495,000	25,125,000	37,496,000

a Probability that return will be at, or below, specified projection.

c Sockeye: 1953-2009 (depending on start of time series)

d Sockeye: 1955-2007 (depending on start of time series)

e Unforecasted miscellaneous Early Summer Stocks (Early Shuswap stocks: S.Thompson; used Scotch/Seymour R/EFS)

f Unforecasted miscellaneous Early Summer stocks (N. Thomson tributaries; used Raft/Fennell R/EFS).

g North Thompson River (used Raft/Fennell R/EFS)

h Chilliwack Lake and Dolly Varden Creek (used Early Summer R/EFS)

i Nahatlach River & Lake (used Early Summer R/EFS)

j Brood year smolts in columns C & D (not effective females)

k Harrison are age-4 (column C) and age-3 (column D).

m Unforecasted miscellaneous Late Run stocks (Harrison Lake down stream migrants including Big Silver, Cogburn, etc.)

Definitions: BY: Brood year; BY07: brood year 2007; BY06: brood year 2006; EFS: effective female spawners; Prod. (8yr), Prod. (4yr): Productivity in recruits-per-effective female spawners in the last 8 yrs or last 4 yrs; Pi (Pine Island sea-surface-temperature covariate); PDO (Pacific Decadal Oscillation covariate); TSA (time series average model); Ei (Entrance Island sea-surface-temperature covariate); R/S (used for stocks with no recruit data--product of R/S for stocks indicated and EFS), cyc (cycle line data only used); FrD-peak (peak Fraser discharge covariate); SSS (sea surface salinity covariate)

Table B2. Spawning escapement plan for Fraser River sockeye (top) and pink salmon (bottom) in 2011. (Provided to the Panel by Fisheries and Oceans Canada).

Escapement Plans for Fraser River Sockeye Salmon						
		p10	p25	p50	p75	p90
Early Stuart	run size	6,000	11,000	17,000	27,000	42,000
pMA	0.63 no fishing point/fixed escapement target:				108,000	
ER floor	10% cut back point:				270,000	
ER cap	60% TAM rule	0%	0%	0%	0%	0%
	Esc. goal	6,000	11,000	17,000	27,000	42,000
	MA	3,800	6,900	10,700	17,000	26,500
	goal + MA	9,800	17,900	27,700	44,000	68,500
	ER after MA	0%	0%	0%	0%	0%
	ER floor	10%	10%	10%	10%	10%
	allowable ER	10%	10%	10%	10%	10%
	allowable catch	1,000	1,000	2,000	3,000	4,000
Early Summer	run size (w misc)	153,000	257,000	453,000	894,000	1,558,000
pMA	0.43 no fishing point/fixed escapement target (w/o misc):				120,000	
ER floor	10% cut back point (w/o misc):				300,000	
ER cap	60% no fishing (w misc)	171,600	170,400	163,700	165,600	151,800
	cut back (w misc)	429,000	426,000	409,300	413,900	379,400
	TAM rule	0%	34%	60%	60%	60%
	Esc. goal	153,000	170,400	181,200	357,600	623,200
	MA	66,400	73,900	78,600	155,100	270,300
	goal + MA	219,400	244,300	259,800	512,700	893,500
	ER after MA	0%	5%	43%	43%	43%
	ER floor	10%	10%	10%	10%	10%
	allowable ER	10%	10%	43%	43%	43%
	allowable catch	15,000	26,000	193,000	381,000	665,000
Summer	run size	590,000	903,000	1,500,000	2,657,000	4,835,000
pMA	0.07 no fishing point/fixed escapement target:				520,000	
ER floor	10% cut back point:				1,300,000	
ER cap	60% TAM rule	12%	42%	60%	60%	60%
	Esc. goal	520,000	520,000	600,000	1,062,800	1,934,000
	MA	36,400	36,400	42,000	74,400	135,400
	goal + MA	556,400	556,400	642,000	1,137,200	2,069,400
	ER after MA	6%	38%	57%	57%	57%
	ER floor	10%	10%	10%	10%	10%
	allowable ER	10%	38%	57%	57%	57%
	allowable catch	59,000	347,000	858,000	1,520,000	2,766,000
Late	run size (w misc)	257,000	516,000	1,207,000	3,288,000	5,648,000
pMA	0.69 no fishing point/fixed escapement target (w/o misc):				400,000	
ER floor	20% cut back point (w/o misc):				1,000,000	
ER cap	60% no fishing (w misc)	404,700	411,200	406,400	403,300	402,600
	cut back (w misc)	1,011,800	1,027,900	1,016,000	1,008,300	1,006,400
	TAM rule	0%	20%	60%	60%	60%
	Esc. goal	257,000	411,200	482,800	1,315,200	2,259,200
	MA	177,300	283,700	333,100	907,500	1,558,800
	goal + MA	434,300	694,900	815,900	2,222,700	3,818,000
	ER after MA	0%	0%	32%	32%	32%
	ER floor	20%	20%	20%	20%	20%
	allowable ER	20%	20%	32%	32%	32%
	allowable catch	51,000	103,000	391,000	1,065,000	1,830,000

Stock Group	Run Size		Total		Escapement Target at Run Size
	Estimate of forecasted stocks	Run Size Reference Points	Mortality Rate Guidelines	Total Allowable Mortality at Run Size	
Fraser Pink		0 7,059,000	0% - 15%		
		7,059,000 17,143,000	15% - 65%		
	17,495,000	17,143,000	65% - 70%	66%	6,000,000

APPENDIX C: COMMISSION GUIDANCE TO THE FRASER RIVER PANEL
(agreed February 17, 2011)

The Commission provides the following direction to the Fraser River Panel with respect to implementation of Paragraphs 3 and 8 of Chapter 4, Annex IV of the Pacific Salmon Treaty.

Notwithstanding provisions of paragraphs 3 (c), 3(d) and 3(e) of Chapter 4 to the contrary:

1. The agreed Fraser River Aboriginal Fishery Exemption (AFE) is up to 400,000 sockeye annually. For computing TAC by stock management group, the AFE shall be allocated to management groups as follows: The Early Stuart sockeye exemption shall be up to 20% of the Fraser River Aboriginal Fishery Exemption (AFE), and the remaining balance of the latter exemption shall be based on the average proportional distribution for the most recent three cycles and modified annually as required to address concerns for Fraser River sockeye stocks and other species and as otherwise agreed by the Fraser River Panel. If either pre-season or in-season, there is insufficient harvestable surplus (defined as run size minus escapement goal, minus management adjustments made pursuant to paragraph 3(b), minus test fishing catches) in any stock management group to allow for the total AFE distribution to that stock management group as described above, the AFE for that stock management group will be the greater of: a) the catch, b) the projected catch by Aboriginal Fisheries or c) the available harvestable surplus. The remaining balance of AFE not distributed to that stock management group will be redistributed to the other stock management groups in the same proportions as specified above, unless otherwise agreed by the Fraser River Panel. The harvest distribution of Early Stuart sockeye is expected to remain similar to that of recent years.
2. For the purpose of computing the aggregate TAC, each Fraser River sockeye stock is assigned to one of four stock management groups. The stock management groups are Early Stuart, Early Summer, Mid-Summer and Late Run. The annual U.S. share available for harvest in the Panel Area is computed by applying the percentage share provided in paragraph 2(a) to the aggregate TAC, defined as the sum of the TACs computed for each of the four stock management groups. To the extent practicable, the Fraser River Panel shall develop and implement a fishing plan that provides the U.S. fishery with the opportunity to harvest its 16.5% aggregate share of the TAC of Fraser River sockeye. To accomplish this, the Panel to the extent practical, shall strive to concentrate the U.S. fishery on the most abundant management group (or groups), i.e., those that provide the largest percentage of the available TAC. It is understood that, despite concentrating the U.S. harvest in this manner, the overlapping of management groups may result in greater than 16.5% of the TAC for one or more of the less abundant management groups being taken by the U.S. fishery. A small but acceptable rate of incidental harvest may occur on one or more overlapping management groups that have little or no TAC as defined in the current Chapter.
3. With respect to paragraph 8 of Chapter 4 the U.S. share shall be adjusted for harvest overages and underages based on post-season catch estimates as follows:
 - (a) The U.S. share shall be adjusted in the amount of any harvest overage or underage of the same species from the previous year or years as provided in subparagraphs (b) and (c), below. In making such adjustment, the U.S. current year share will not be reduced by more than 5 percent nor increased by more than 15 percent because of the adjustment, unless otherwise agreed. The Fraser River Panel shall attempt to fully implement any adjustments to the U.S. share by the expiration of this Chapter. Any remaining balance from the harvest overage or underage shall be incorporated in the subsequent year's allocation. Any residual overage or underage remaining at the last year of this Chapter shall be carried forward into the next Chapter period.

- (b) The U.S. share will be adjusted to account for management imprecision in U.S. fisheries subject to the limitations prescribed in subparagraph (c). Additionally, the U.S. share will be adjusted for underages which occur as a result of Canada directly impeding the U.S. from pursuing its in-season share of the TAC. This latter circumstance will be noted in-season by the Panel including the effect Canada's catch had on impeding the U.S. pursuit of its in-season share, and will be compensated for as an underage pursuant to paragraph (a).
- (c) The U.S. share will not be adjusted:
 - (i) for underages which occur because the U.S. fishery failed to deploy sufficient effort;
 - (ii) for underages which occur because too few fish were available to the U.S. fishery due to migration patterns (e.g., diversion rates) or harvesting constraints for intermingled stocks or species; or
 - (iii) for that portion of an underage resulting from an increase in the estimated TAC identified after the year's fishery has ended but which would not have been available due to harvest constraints for intermingled stocks or species.
 - (iv) for an overage resulting from TAC reductions after the scheduling of the last Fraser River Panel approved U.S. fishery of the season.
- (d) The Fraser River Panel shall develop agreed procedures for implementing this guidance as part of its preseason planning process.
- (e) Fisheries that occur after the last U.S. Fraser River Panel approved fishery are expected to remain similar to those of recent years.

APPENDIX D: 2011 FRASER RIVER PANEL MANAGEMENT PLAN PRINCIPLES AND CONSTRAINTS (agreed June 16, 2011)

1. Fisheries and Oceans Canada (DFO) has provided the Panel with run-size forecasts for Fraser River sockeye and pink salmon. DFO stated that the Fraser River sockeye run-size forecasts remain highly uncertain due to variability in annual survival rates and uncertainty about changes in their productivity. For pre-season planning purposes, the Panel used the 50% probability levels of abundance for the forecasted sockeye stocks (3,177,000) that were based on recent productivity assumptions. This forecast is lower than would be expected based on long-term average productivity (4,627,000). To put the sockeye run size forecast uncertainty into context, there is a one in four chance at the 25% probability level that the actual number of returning sockeye will be at or below 1,687,000 fish and there is a three in four chance at the 75% probability level that the actual number of returning sockeye will be at or below 6,866,000 fish. The pre-season forecast for Fraser River pink salmon is also highly uncertain since the forecast is outside of the historic data range due to the record high fry outmigration from the 2009 brood year. For pre-season planning of Fraser River pink salmon, the Panel used the 50% probability level forecast of 17,495,000 fish, which was based on long-term average productivity assumptions.
2. The Panel's first priority in 2011 is to achieve conservation objectives for all stocks, including Late-run sockeye objectives as indicated in the document, "Guidelines for Pre-season Fraser Sockeye Fishing Plans to Address Late-Run Concerns". The Panel will manage fisheries based on four stock groupings. Birkenhead sockeye, including Big Silver and other miscellaneous stocks, are included with the Late-run timing group.
3. 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 a significant proportion will not survive to spawn. The Panel may update its assumptions about Late-run upstream timing and mortality based on advice from PSC staff, during the in-season management period.
4. TAC and international shares will be calculated according to the February 17, 2011 Commission Guidance to the Fraser River Panel and the 2005 revised Annex IV, Chapter 4, of the Pacific Salmon Treaty, which limits the United States harvest (in Washington State) to 16.5% of the total allowable catch (TAC) of Fraser River sockeye salmon. Based upon the 50% probability levels of abundance, for the purposes of computing TAC by stock management grouping in 2011, the Panel agreed that the Fraser River Aboriginal Exemptions are as follows: Early Stuart sockeye, 1,000 fish, Early Summer-run sockeye, 46,800 fish; Summer-run sockeye, 260,400 fish; and Late-run sockeye, 91,800 fish. There is no available harvest of Early Stuart sockeye at the 50% probability level of abundance. With respect to Fraser River pink salmon, under the terms of Annex IV, Chapter 4, of the Pacific Salmon Treaty, the United States share of the TAC is 25.7%, while the Canadian share is 74.3%.
5. For planning fisheries, the Panel has adopted the 50% probability level forecasts for Early Stuart (17,000 fish), Early Summer-run (453,000 fish), Summer-run (1,500,000 fish), Late-run sockeye (1,207,000 fish) and for Fraser River pink salmon (17,495,000 fish). When sufficient information is available in-season, the Panel will update run size estimates of Fraser River sockeye and pink salmon, as appropriate.

Regulations

- i) If the abundance of Early Summer-run sockeye salmon is tracking at approximately the 50% probability level (453,000 fish) and the abundance of Summer-run sockeye salmon is tracking at approximately the 50% probability level (1,500,000 fish) and the runs arrive at or near expected dates, low impact fisheries would be expected to commence during late July in Panel Waters. If the return abundances of Early Summer-run and Summer-run sockeye vary from the 50% probability level forecast, this could change the start dates, and duration of fisheries.
- ii) The Parties' conservation concerns for other species and stocks will be taken into account throughout the 2011 management season.

APPENDIX E: GUIDELINES FOR PRE-SEASON FRASER SOCKEYE FISHING PLANS TO ADDRESS LATE-RUN ¹³ CONCERNS (agreed June 16, 2011)

The 2011 cycle is the sub-dominant-line cycle for Adams River sockeye. Late-run sockeye have generally produced smaller returns on this cycle line than Summer-run sockeye. Harrison, Adams/Late Shuswap, and Weaver sockeye are the predominant Late-run sockeye stocks returning in 2011. The total forecast for Late-run sockeye in 2011 (1,207,000 fish at the 50% probability level) is lower than average for the cycle. The potential continuation of a high in-river mortality rate experienced by several Late-run stocks in recent years continues to be a serious conservation concern. Additionally, there is special concern for the very depressed Cultus sockeye run for which recovery efforts have been implemented by Canada to ensure this stock's long-term viability. A coordinated approach to management will be developed that reflects both Parties sharing the burden of conservation for Late-run sockeye.

ASSUMPTIONS AND ELEMENTS OF THE PLAN

1. For fisheries planning purposes, a precautionary approach was applied and it was assumed that Late-run sockeye will continue their post-1995 early upstream migration behaviour. Given pre-season assumptions about marine timing and recent delay behaviour, the median upstream migration date for Late-run sockeye in 2011 is expected to occur on August 27. Given this timing, the expected difference between estimates, and based on the 50% probability level forecast of abundance (1,207,000 fish), the available exploitation rate is 32%.
2. The pre-season fishing plan assumes a 4 day separation in the 50% marine migration timing date (through Juan de Fuca Strait; Area 20) between Summer-run (August 7) and Late-run sockeye (August 11).
3. Estimates of abundance, migration timing, etc., for Summer-run and Late-run sockeye will be provided in-season and PSC staff will advise the Panel if changes to pre-season assumptions are warranted.
4. Staff will not be able to provide in-season stock-specific assessments for Cultus sockeye due to their low forecast abundance (9,000 fish at the 50% probability level) relative to much more abundant co-migrating stocks. Consequently, assessments of Cultus sockeye harvest impacts will rely on the use of other, more abundant Late-run stocks as indicators of their relative contribution to catches.
5. To help ensure that Late-run conservation objectives are achieved, fisheries directed at Summer-run sockeye and Fraser River pink salmon will be constrained as necessary by potential harvests of Late-run sockeye. Late-run sockeye catches will be estimated primarily with DNA stock identification methods.

¹³ Late-run here refers to the Late-run timing group, excluding Birkenhead and a few minor miscellaneous sockeye stocks.

APPENDIX F: 2011 REGULATIONS

The Fraser River Panel approved regulations for the management of the Fraser River sockeye and pink 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, 2011.

Canadian Fraser River Panel Area

In accordance with Article VI, Paragraph 5 of the Pacific Salmon Treaty, the Commission recommends to the Canadian Government the adoption of 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 3rd day of July, 2011, to the 17th day of September, 2011, 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 3rd day of July, 2011, to the 17th day of September, 2011, 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 3rd day of July, 2011 to the 1st day of October, 2011, 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 3rd day of July, 2011, to the 1st day of October, 2011, 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 3rd day of July, 2011, to the 15th day of October, 2011, both dates inclusive.
 - b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 29 from the 3rd day of July, 2011, to the 15th day of October, 2011, 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 2011 season, the Fraser River Panel will adopt Orders establishing open fishing periods based on a 2011 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 3rd day of July, 2011 to the 17th day of September, 2011, 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 3rd day of July, 2011, to the 1st day of October, 2011, 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 2nd day of October, 2011, to the 8th day of October, 2011, both dates inclusive.

All-Citizen Fisheries:

4. 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 3rd day of July, 2011, to the 17th day of September, 2011, both dates inclusive.
5. 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 3rd day of July, 2011, to the 1st day of October, 2011, both dates inclusive.
6. 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 2nd day of October, 2011, to the 8th day of October, 2011, both dates inclusive.

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

Treaty Indian and All-Citizen Fisheries:

7. High Seas westerly of the Bonilla Point-Tatoosh Island Lighthouse Line.
8. Puget Sound Salmon Management and Catch Reporting Areas 6B, 6D, 7B, 7C, 7D and 7E.

During the 2011 season, the Fraser River Panel will adopt Orders establishing open fishing periods based on a 2011 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 G: 2011 FRASER RIVER PANEL IN-SEASON ORDERS

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

July 26, 2011

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Open to drift gillnets from 6:00 p.m., Tuesday, July 26, 2011 to 12:00 p.m. (noon) Saturday, July 30, 2011.

July 29, 2011

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Saturday, July 30, 2011 to 12:00 p.m. (noon), Wednesday, August 3, 2011.

August 2, 2011

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Wednesday, August 3, 2011 to 12:00 p.m. (noon), Thursday, August 4, 2011.

August 3, 2011

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Thursday, August 4, 2011 to 12:00 p.m. (noon), Saturday, August 6, 2011.

Areas 6, 7, and 7A

Open to net fishing from 5:00 a.m. Thursday, August 4, 2011 to 9:00 a.m. Friday, August 5, 2011.

All Citizen Fishery

Areas 7 and 7A

Open to gillnets from 2:00 p.m. to 11:59 p.m. (midnight) Friday, August 5, 2011.

Areas 7 and 7A

Open to purse seines from 9:00 a.m. to 7:00 p.m. Friday, August 5, 2011.

Areas 7 and 7A

Open to reefnets from 5:00 a.m. to 3:00 p.m. Saturday, August 6, 2011.

August 5, 2011

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Saturday, August 6, 2011 to 12:00 p.m. (noon), Tuesday, August 9, 2011.

Areas 6, 7, 7A

Open to net fishing from 5:00 a.m.-11:59 p.m. Saturday, August 6, 2011.

August 8, 2011

United States

Treaty Indian Fishery

Areas 4B, 5, and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Tuesday, August 9, 2011 to 12:00 p.m. (noon), Wednesday, August 10, 2011.

August 9, 2011

Canada

Area 29: Subareas 29-11 to 29-17 and portions of Subareas 29-3, 29-4, 29-6, 29-7, 29-9 and 29-10

Revised to open for Area E gillnets from 12:00 p.m. (noon) to 3:00 p.m. Thursday, August 11, 2011.

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Wednesday, August 10, 2011 to 12:00 p.m. (noon), Saturday, August 13, 2011.

Areas 6, 7, and 7A

Open to net fishing from 5:00 a.m. to 11:59 p.m. (midnight) Wednesday, August 10, 2011.

All Citizen Fishery

Areas 7, and 7A

Open to gillnets from 8:00 a.m. to 11:59 p.m. (midnight) Thursday, August 11, 2011.

Areas 7, and 7A

Open to purse seines from 9:00 a.m. to 5:00 p.m. Thursday, August 11, 2011.

Areas 7, and 7A

Open to reefnets from 5:00 a.m. to 9:00 p.m. Thursday, August 11, 2011.

August 12, 2011

Canada

Area 29: Portions of 29 – 3, 4, 6, 7, 9, 10 and 11 to 17

Open to Area E gillnets from 10 a.m. to 4:00 p.m., Tuesday, August 16, 2011.

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Saturday, August 13, 2011 through 12:00 p.m. (noon) Tuesday, August 16, 2011.

All Citizen Fishery

Areas 7, and 7A

Open to gillnets from 12:00 p.m. (noon) to 11:59 p.m. (midnight) Sunday, August 14, 2011.

Areas 7, and 7A

Open to purse seines from 10:00 a.m. to 4:00 p.m. Monday, August 15, 2011.

Areas 7, and 7A

Open to reefnets from 12:00 p.m. (noon) to 8:00 p.m. Saturday, August 13, 2011 and from 12:00 p.m. (noon) to 8:00 p.m. Sunday, August 14, 2011.

August 15, 2011

Canada

Area 29 – 1 to 6

Open to Area H troll ITQ fishery 12:01 a.m., Tuesday, August 16, 2011, until further notice.

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon), Tuesday, August 16, 2011 through 12:00 p.m. (noon) Wednesday, August 17, 2011.

August 19, 2011

Canada

Area 29: Portions of 29 – 3, 4, 6, 7, 9, 10 and 11 to 17

Open to Area E gillnets from 11:00 a.m. to 1:00 p.m., Tuesday, August 23, 2011.

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Open for drift gillnets from 12:00 p.m. (noon) Saturday, August 20 through 12:00 p.m. (noon) Wednesday, August 24, 2011.

Areas 6, 7, and 7A

Open to net fishing from 5:00 a.m. Monday, August 22, 2011 through 9:00 a.m. Tuesday, August 23, 2011.

August 23, 2011

Canada

Area 18-1, 18-4, 18-11

Open to Area H troll ITQ fishery 12:01 a.m. Friday, August 26, 2011 until further notice.

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Wednesday, August 24, 2011 through 12:00 p.m. (noon) Saturday, August 27, 2011.

Areas 6, 7, and 7A

Open to net fishing from 5:00 a.m. Thursday, August 25, 2011 through 11:59 p.m. (midnight) Friday, August 26, 2011.

All Citizen Fishery

Areas 7 and 7A

Open to gillnets from 8:00 a.m. to 11:59 p.m. (midnight) Wednesday, August 24, 2011.

Areas 7 and 7A

Open to purse seines from 5:00 a.m. to 9:00 p.m. Wednesday, August 24, 2011.

Areas 7 and 7A

Open to reefnets from 5:00 a.m. to 9:00 p.m. Wednesday, August 24, 2011, Thursday, August 25, 2011, and Friday, August 26, 2011.

August 26, 2011

Canada

Area 29-11 to 29-17 and portions of Area 29-9

Open to Area E gillnet from 9:00 a.m. Tuesday, August 30, 2011 until 3:00 p.m. with a possible extension of 4 hrs.

Portions of Area 29-6, 29-7, 29-9

Open to Area B seine ITQ fishery from 6:00 a.m. to 9:00 p.m. daily from Saturday August 27, 2011 through Tuesday, August 30, 2011.

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Saturday, August 27, 2011 through 12:00 p.m. (noon) Tuesday, August 30, 2011.

All Citizen Fishery

Areas 7 and 7A

Open to reefnets with non-retention of sockeye salmon from 5:00 a.m. to 9:00 p.m. Saturday, August 27, 2011, Sunday, August 28, 2011, and Monday August 29, 2011.

August 29, 2011

Canada

Area 29-9, 29-11 to 29-17

Open to Area E gillnets from 1:00 p.m. Tuesday, August 30, 2011 until 7:00 p.m. Tuesday, August 30, 2011.

Area 29-6, 29-7, 29-9

Open to Area B seine ITQ fishery from 6:00 a.m. to 9:00 p.m. daily from Wednesday August 31, 2011 to Friday, September 2, 2011.

United States

Treaty Indian Fishery

Areas 4B, 5, 6C

Extended for drift gillnets from 12:00 p.m. (noon) Tuesday, August 30, 2011 through 12:00 p.m. (noon) Friday, September 2, 2011.

Areas 6, 7, 7A

Open to net fishing from 5:00 a.m. until 11:59 p.m. (midnight) Tuesday, August 30, 2011.

All Citizen Fishery

Areas 7 and 7A

Open to reefnets with non-retention of sockeye salmon from 5:00 a.m. to 9:00 p.m. Tuesday, August 30, 2011, Wednesday, August 31, 2011 and Thursday, September 1, 2011.

Areas 7 and 7A

Open to gillnets with non-retention of sockeye salmon from 8:00 a.m. to 11:59 p.m. (midnight) Wednesday, August 31, 2011.

Areas 7 and 7A

Open to purse seines with non-retention of sockeye salmon from 5:00 a.m. to 9:00 p.m. Wednesday, August 31, 2011.

September 1, 2011

Canada

Area 29-6, 29-7, 29-9

Open to Area B seine ITQ fishery from 6:00 a.m. to 9:00 p.m. daily from Saturday, September 3, 2011 through Tuesday, September 6, 2011, for the retention of pink salmon only.

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Friday, September 2, 2011 through 12:00 p.m. (noon) Wednesday, September 7, 2011.

Areas 6, 7, and 7A

Open to net fishing from 5:00 a.m. Friday, September 2, 2011 until 11:00 a.m. Sunday, September 4, 2011, in the area southerly and easterly of a straight line drawn from Iwersen's dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

All Citizen Fishery

Areas 7 and 7A

Open to gillnets with non-retention of sockeye salmon from 11:00 a.m. to 11:59 p.m. (midnight) Sunday, September 4, 2011, in the area southerly and easterly of a straight line drawn from Iwersen's dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

Areas 7 and 7A

Open to purse seines with non-retention of sockeye salmon from 11:00 a.m. to 9:00 p.m. Sunday, September 4, 2011, in the area southerly and easterly of a straight line drawn from Iwersen's dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

Areas 7 and 7A

Open to reefnets with non-retention of sockeye salmon daily from 5:00 a.m. to 9:00 p.m. Friday, September 2, 2011 through Tuesday, September 6, 2011.

September 2, 2011

United States

Treaty Indian Fishery

Areas 6, 7, and 7A

Open to net fishing from 5:00 a.m. Monday, September 5, 2011 until 9:00 a.m. Tuesday, September 6, 2011, in the area southerly and easterly of a straight line drawn from Iwersen's dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

All Citizen Fishery

Areas 7 and 7A

Open to gillnets with non-retention of sockeye salmon from 8:15 a.m. to 11:59 p.m. (midnight) Tuesday, September 6, 2011, in the area southerly and easterly of a straight line drawn from Iwersen's dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

Areas 7 and 7A

Open to purse seines with non-retention of sockeye salmon from 5:00 a.m. to 9:00 p.m. Tuesday, September 6, 2011, in the area southerly and easterly of a straight line drawn from Iwersen's dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

September 6, 2011

Canada

Area 29-3, -4, -6, 29-7, 29-9

Portions of these subareas open to Area B seine ITQ fishery from 6:00 a.m. to 9:00 p.m. daily from Wednesday, September 7, 2011 until further notice, for the retention of pink salmon only.

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Wednesday, September 7, 2011 through 9:00 a.m. Friday, September 9, 2011.

Areas 6, 7, and 7A

Open to net fishing from 5:00 a.m. Wednesday, September 7, 2011 until 9:00 a.m. Friday, September 9, 2011, in the area southerly and easterly of a straight line drawn from Iwersen's dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

All Citizen Fishery

Areas 7 and 7A

Open to reefnets with non-retention of sockeye salmon from 5:00 a.m. to 9:00 p.m. Wednesday, September 7, 2011 and Thursday, September 8, 2011.

September 8, 2011

Canada

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

Portions of these subareas open to Area B seine ITQ fishery from 6:00 a.m. to 9:00 p.m. Friday, September 9, 2011, for the retention of pink salmon only.

September 9, 2011

Canada

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

Portions of these subareas open to Area B seine ITQ fishery from 6:00 a.m. to 9:00 p.m. daily from Saturday, September 10, 2011, through Tuesday, September 13, 2011 for the retention of pink salmon only.

September 12, 2011

Canada

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

Portions of these sub-areas open to Area B seine ITQ fishery from 6:00 a.m. to 9:00 p.m. daily from Wednesday, September 14, 2011 through Friday, September 16, 2011 for the retention of pink salmon only.

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Open for drift gillnets from 5:00 a.m. until 11:59 p.m. (midnight) Tuesday, September 13, 2011.

Areas 6, 7 and 7A

Open to net fishing from 5:00 a.m. until 11:59 p.m. (midnight) Tuesday, September 13, 2011, in the area southerly and easterly of a straight line drawn from Iwersen's dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

September 14, 2011

Canada

Area 18-1, 18-4, 18-11

Area B seine ITQ fishery opens for pink salmon, with non-retention of sockeye salmon, 6:00 a.m. to 9:00 p.m. daily from Thursday, September 15, 2011 through Friday, September 16, 2011.

September 16, 2011

Canada

Area 29-1 to 6

Area H troll ITQ fishery continues until Friday, September 23, 2011, for the retention of pink salmon only.

Area 18-1, 18-4, 18-11

Area H troll ITQ fishery continues until Friday, September 23, 2011, for the retention of sockeye and pink salmon.

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

Portions of these sub-areas open to Area B seine ITQ fishery from 6:00 a.m. to 9:00 p.m. daily from Saturday, September 17, 2011 through Friday, September 23, 2011 for the retention of pink salmon only.

Area 18-1, 18-4, 18-11

Area B seine ITQ fishery opens for pink salmon, with non-retention of sockeye salmon, 6:00 a.m. to 9:00 p.m. daily from Saturday, September 17, 2011 through Friday, September 23, 2011.

September 19, 2011

United States

Areas 6 and 7

Relinquish regulatory control effective 11:59 p.m. (midnight), Saturday, September 24, 2011.

Area 7A

The area easterly of the East Point Light line will be relinquished as scheduled at 11:59 p.m. (midnight) on Saturday, October 1, 2011. The remainder of Area 7A (westerly of the East Point Light line) will be relinquished as scheduled at 11:59 p.m. (midnight) on Saturday, October 8, 2011.

September 21, 2011

Canada

Area 29-13, 29-14, 29-17

Portions of these subareas open to Area B seine ITQ fishery from 6:00 a.m. to 9:00 p.m. daily until Friday September 23, 2011, for the retention of pink salmon only. This is a limited effort, shallow seine experimental fishery.

Area 29 – 1 to 6

Area H troll ITQ fishery continues for the retention of pink salmon only but will close on Friday, September 23, 2011 at 11:59 p.m. (midnight).

Area 18-1, 18-4, 18-11

Area H troll ITQ fishery continues for the retention of sockeye and pink salmon but will close on Friday September 23, 2011 at 11:59 p.m. (midnight).

Fraser River Panel control of Canadian Panel Areas was relinquished in accordance with the pre-season Regulations (Appendix F) as follows: Area 20 on September 17; Areas 17 and 18 on October 1; and Area 29 on October 15. Panel control of United States Panel Areas were relinquished as follows; Areas 4B, 5 and 6C on September 17 in accordance with the pre-season Regulations; Areas 6 and 7 on September 24 by in-season order; portions of Area 7A on October 1 in accordance with the pre-season Regulations; and the remaining portions of Area 7A on October 8 in accordance with the pre-season Regulations.

APPENDIX H: 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 route. In conjunction with stock composition information from the Stock Identification Group, 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. 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 migrations 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 4 in the main body of the report summarizes the locations and temporal patterns of Panel-approved test fisheries, Table H1 summarizes more detailed information about the nets and sampling strategies employed.

Table H1. Sampling details for Panel-approved test fisheries conducted in 2011.

Area	Name	Gear	Number	Net	Net	Mesh		Number	Set
			of	Length	Depth	Size	of		
			Vessels	(m)	(meshes)	(mm)	(in)	Sets	(minutes)
Canadian Panel Areas									
20	Juan de Fuca Str.	Gillnet	2	547	90	130	5 1/8	2	300
20	Juan de Fuca Str.	Purse Seine	1	547	875	95	3 3/4	6	20
29-1 to 6	Str. of Georgia	Troll	2	n/a	n/a	n/a	n/a	n/a	n/a
29-14	Fraser R. (Cottonwood)	Gillnet	1	292	Variable	Variable		1	30
29-16	Fraser R. (Whonnock)	Gillnet	1	319	Variable	Variable		2	20
29-16	Fraser R. (Mission)	Gillnet	1	30	30	133	5 1/4	1-3	Variable
United States Panel Areas									
5	Juan de Fuca Str.	Gillnet	1	803	220	130	5 1/8	2	400
7	San Juan Islands	Reefnet ¹	3	n/a	n/a	n/a	n/a	n/a	n/a
Canadian Non-Panel Areas									
12	Queen Charlotte Str. (Round Is.)	Gillnet ²	1	365	60-90	95	3 3/4	4	100
12	Johnstone Str. (Naka Cr.)	Gillnet ²	1	365	90	130	5 1/8	4	100
12	Johnstone Str. (Blinkhorn)	Purse Seine	1-2	401	575	95	3 3/4	6	20
13	Lower Johnstone Str.	Purse Seine	1	401	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 and Naka Creek vessels a 90 Mesh Alaska twist 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), but is augmented during the early part of the season by test fisheries in U.S. Areas 4B and 5 (Juan de Fuca Strait) and Area 7 (San Juan Islands). 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. An experimental gillnet test fishery near Mission was conducted in August and early September when large numbers of pink salmon were present, to provide species composition

information for the Mission hydroacoustic estimates. When the Mission hydroacoustic program is not active or when high abundances of pink salmon confounds estimates of sockeye proportions migrating upstream, lower river (Area 29) test fisheries provide passage estimates through the use of CPUE models.

As a result of the poor brood year return of Early Stuart sockeye in 2007 (5,300 spawners) and low forecasted return in 2011 (p50% 17,000 sockeye), the marine gillnet test fisheries were delayed until July 11, when most Early Stuart sockeye were thought to have migrated past the test fishery sites. In July, daily catches in the Area 20 gillnet test fishery were larger compared to the brood year, but less than the cycle year average. In August, daily catches in the Area 20 gillnet test fishery were lower than both brood year and cycle year average daily catches. In contrast, daily catches in the Area 12 (Round Island) gillnet test fishery in July were modest compared to the brood year and increased with the increased sockeye diversion through Johnstone Strait in August. Purse seine catches in Areas 12 and 13 were similarly modest through July, with several increases in abundance observed between August 3-11 and August 13-18. Catches in the Area 20 purse seine test fishery were similar to the cycle year daily average.

The Cottonwood and Whonnock gillnet test fisheries in the lower Fraser River were affected by the high river discharge levels in late June and early July. One impact was that the start date of the Cottonwood test fishery was delayed until July 23. A second impact was that daily catches at Whonnock were very low compared to previous years, and provided only a weak signal about sockeye migration timing and species composition. Fewer than 10 sockeye per day were caught at Whonnock prior to July 23. Corresponding daily peak sockeye catches and abundances occurred at Cottonwood on August 8, August 21 and September 9, at Whonnock on August 9, August 22 and September 11, and at Mission on August 9-10, August 22-23 and September 11. As in recent years, seal predation at both Fraser River gillnet test fishing sites remained a source of concern. The number of seals observed per day, however, was less than the maximum number of seals observed per day in 2007.

Purse seine test fishery catches of pink salmon in Juan de Fuca Strait were lower than in the brood year while in Johnstone Strait they were similar to the brood year. The combined abundances of Fraser pinks through the marine approaches resulted in one of the largest pink salmon returns on record. Pink salmon catches at Whonnock were the largest on record, and likely signalled one of the larger spawning escapements of pink salmon in the Fraser River.

The timing and abundance of sockeye and pink salmon migrations, as indicated by daily visual counts at Hells Gate, were confirmed by hydroacoustics observations at DFO's Qualark site (located below Hells Gate near Hope). Sockeye and pink salmon observed at Hells Gate were in good condition.

B. Mission Hydroacoustics

PSC Staff have operated a hydroacoustic facility on the Fraser River near the Mission Bridge since 1977, for the purpose of providing timely in-season estimates of sockeye and pink salmon escapement through the lower river. This program has benefited from improved technologies and research in recent years^{14,15}. In 2011, daily abundance at Mission was estimated using a split-beam hydroacoustic system on the left (south) bank of the Fraser River, a split-beam system mounted on a vessel that runs back and forth across the river, and a Long Range Dual frequency IDentification SONar system (LR DIDSON) on the right (north) bank. The 3 sonar systems operated 24-hrs/day and provided information about the density, behaviour, speed and direction of travel of fish targets, as well as size distribution. In addition, 3 additional standard DIDSON units were used to

¹⁴ 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.

¹⁵ Xie, Y., C. G. J. Michielsens, A. P. Gray, F. J. Martens, and J. L. Boffey. 2009. Observations of avoidance reactions of migrating salmon to a mobile survey vessel in a riverine environment. *Can. J. Fish. Aquat. Sci.* 65: 2178-2190.

gather independent diagnostic information for the purpose of verifying assumptions used in the estimation procedure. Flux estimates from these additional DIDSONs were used post-season to augment daily abundance estimates, particularly during the pink migration period.

Daily estimates of fish abundance past Mission are produced by combining estimates from shore-based and vessel-based sonar systems. The left-bank shore-based split-beam system consisted of two side-looking split-beam elliptical transducers ($2^\circ \times 10^\circ$ and $4^\circ \times 10^\circ$) attached to a rotator to control pan and tilt of the transducer units, thereby allowing direct sampling of almost all of the water column by the narrow sonar beams at multiple aiming angles. The aim and orientation of the transducers were monitored and verified with an attitude sensor. An extendable fish-deflection weir prevented fish from swimming in acoustic blind zones (behind or too close to the transducers), and also increased the duration for which they were insonified. This ensured adequate numbers of echoes for tracking individual fish, particularly pink salmon which typically migrate close to shore. Transducer aims were optimized to minimize the unsampled areas where migratory abundance must be estimated by extrapolation. The vessel-based system consisted of a downward-looking split-beam circular-beam transducer (15°) that transected the river every five minutes to obtain target density information. The right-bank shore-based LR DIDSON system has a 30° horizontal beam-width which consists of 48 fan-shaped composite beams and a 14° vertical beam allowing sampling of nearly the entire water column. Data can be collected at different frequencies (high frequency or low frequency) and at different ranges (0-80m). Only files recorded on low frequency and with a range window of 12 to 32m were used for the in-season daily estimate. The aim and orientation of the DIDSON was monitored and verified with an orientation sensor. Similar to the left-bank, a telescopic fish deflection weir prevented fish from swimming in acoustic blind zones (behind or too close to the DIDSON), and also increased the duration for which they were insonified. The right-bank LR DIDSON system started operation on August 12, and was used in the daily estimate after this date.

Traces of individual fish as they passed through the sound beam were acquired by analyzing the echo data from both shore and vessel-based split-beam systems using an alpha-beta tracker^{16,17}. The resulting trace data (i.e., “tracks”) were classified as fish or noise (e.g., debris, air bubbles) using statistical methods¹⁸ (i.e., DFA or “discriminate function analysis”). The integrity of statistically identified fish tracks was further verified by trained staff, and unusual or atypical targets were removed using graphical user interface (GUI) software. This data processing procedure was performed each day for all the data collected from both the left-bank split-beam and vessel-based systems. Final fish track data were imported to a fish-flux estimation software. Daily fish passage in the areas sampled by the left-bank and mobile split-beam systems was then estimated from the software, which also projected fish flux through the unsampled areas¹⁷. Daily low frequency DIDSON files for upstream fish were counted using a hand tally counter. These counts were expanded in time to estimate daily fish passage near the right-bank area. The daily total salmon passage was estimated by summing daily flux estimates produced by the 3 sonar systems. Total salmon estimates were further apportioned by species and sockeye stocks based on species composition and stock identification information obtained from lower river test fisheries. Due to the large uncertainty in test fishing-based estimates of sockeye proportions when pink salmon dominate the total salmon migration, Whonnock test fishery CPUE data was used to estimate daily upstream passage of sockeye salmon after August 29.

In addition to the split-beam/DIDSON program at Mission several other experimental programs were conducted in 2011. This included a standard DIDSON unit on the left-bank, a mid-channel DIDSON sampling experiment and a Biosoncis DT-X split-beam system as a vessel based estimator. Also included in the 2011 program were exchanges of data and comparison of estimates from the hydroacoustic programs at Mission and DFO’s Qualark site.

¹⁶ Blackman, S. S. and R. Popoli. Design and Analysis of Modern Tracking Systems. Artech House, Boston, 1999.

¹⁷ 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.

¹⁸ 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.

i. DIDSON insonification of near-shore fish passage

An important application of DIDSON technology in the 2011 field season was to insonify and estimate fish passage in near-shore areas of both the left and right banks at Mission. To achieve this goal a standard DIDSON unit was deployed on the left-bank from July 12 -September 27, and a Long Range DIDSON unit was deployed on the right-bank from August 12- September 27. These systems collected continuous daily fish passage data up to 20 m off shore using a systematic sampling scheme. The DIDSON technology proved to be much more robust than the conventional split-beam sonar technology in enumerating pink salmon passage in September, when extremely high passage densities occurred in near-shore waters. A calculation procedure that included the left and right-bank DIDSON counts in the estimation model was developed. Post-season estimates of Mission passage based on this procedure incorporated these estimates of near-shore salmon passage.

ii. Mid-channel sampling experiment under SEF

As a special project funded by the Southern Boundary Restoration and Enhancement Fund, a mid-channel sampling experiment was conducted from August 15 to September 27 at the Mission site. The goal of the study was to improve the accuracy and precision of daily salmon estimation in the offshore area¹⁹. Two standard DIDSON systems looking upward from bottom-mounted tripods were placed in areas where estimates are currently derived from systems deployed on the transecting vessel. The two units were deployed offshore on the right and left bank from August 15 - September 27 and September 6 - 22, respectively. Similar to the near-shore DIDSONs, a post-season calculation procedure was developed that incorporated off-shore fish passage data from the right-bank DIDSON into the current estimation model. Data collected from the left-bank offshore DIDSON could not be used for the estimation model because its location in a high-flow area with an uneven bottom affected the stability of the equipment, and therefore the quality of the data. Data from both offshore DIDSONs, however, were usable for fish behavior statistics and the mobile flux portion of the estimate. Assessment of the use of offshore DIDSON data for estimating Mission passage is on-going.

iii. Biosonics DT-X as a vessel based estimator

With the acquisition of a split-beam Biosonics DT-X system in 2009 one of our objectives was to test the system as an alternative to the current split-beam HTI vessel-based system. A towed body was designed to house the 6° transducer, and data were collected in a downward looking mode off the vessel on September 8-14 and September 16-27. The system was very robust and no data loss occurred while in operation. The DT-X split-beam raw data was post-processed using a single-target detector with a set of key parameters that was developed in-house¹⁹. The processed single-target data allowed for target tracking of individual fish. The raw data provided operators with graphic representations of echo intensity to better separate fish tracks from non-fish targets such as river bottom or debris, unlike the current split-beam HTI vessel-based system.

iv. In-season data exchange with DFO's Qualark hydroacoustic site and comparison of estimates

2011 was the fourth consecutive season that DFO operated an in-season hydroacoustic monitoring site using DIDSON systems at Qualark Creek (95 km upstream from Mission). PSC and DFO staff at the Mission and Qualark sites exchanged daily salmon estimates beginning in mid-July. By the end of the season, regular information exchanges occurred 2-3 times each week. This timely exchange of information between the two sites greatly enhanced Staff confidence in the in-season estimates of sockeye salmon passage in 2011. Estimates of daily salmon passage at the PSC Mission site were higher than at the DFO Qualark site prior to the heavy in-river migration of pink salmon in late August. The direction of this deviation is consistent with the fact

¹⁹ Xie, Y., F. J. Martens and Andrew P. Gray. 2010. A feasibility study on using a stationary hydroacoustic sub-sampling method to estimate offshore fish flux in the lower Fraser River: A project report to Southern boundary restoration and enhancement fund. Pacific Salmon Commission, Vancouver, British Columbia. February, 2010.

that Mission estimates included a relatively large lower river component that was not bound for Qualark (more than 40% of the Mission sockeye estimate through August 21 was associated with lower Fraser tributaries). During pink-dominated periods in September, estimates of daily salmon at the two sites tracked each other very well in terms of their temporal pattern, although the Mission program estimated many more pink salmon. For the pink salmon time period (August 29-September 27), Qualark estimated a total of 4.7 million salmon while Mission estimated a total of 10.6 million. Such a difference is expected since most pink salmon that migrate past Mission spawn below Qualark.

Detailed examinations of the Mission left-bank split-beam data indicated that the system was unable to enumerate the near-shore (within 20 m) passage when the hourly passage rate reached 5,000 fish per hour. A post-season estimate of daily salmon passage incorporated the inshore and offshore DIDSON data into the estimation procedures. The post-season estimate of total passage was 13,702,000 pink salmon, 3,100,000 higher than the in-season estimate. The future use of inshore and offshore DIDSONs for enumerating salmon passage at Mission, especially in pink salmon return years, is currently under review.

Stock Identification

PSC staff conduct programs designed to identify the 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 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 2011 used DNA and scale pattern analyses from fish caught in marine and in-river fisheries. For pink salmon, 2011 was the third year that stock identification relied on DNA analyses rather than the protein electrophoretic techniques used previously. These analyses were applied to pink salmon mixtures sampled from marine fisheries only. For both sockeye and pink salmon, a new multinomial extrapolation procedure that fit time trends to historical data and prior in-season sample results was used to predict stock composition estimates in future catches and in samples that had not yet been analyzed. For pink salmon, these extrapolations used prior information from stock composition estimates in previous years whereas, for sockeye, only information from 2011 samples was used. Evaluation of these procedures and refinements to them are ongoing and are expected to continue for several years.

A. Sockeye Salmon

Stock identification methods for sockeye salmon relied on analyses of DNA²⁰ (using the program CBAYES²¹) and scale patterns²², which 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”). In addition, the absence of adipose fins was useful for detecting the presence of hatchery-supplemented populations (Cultus Lake and Sakinaw Lake).

Samples from test fishery catches were analyzed daily, beginning in late June and continuing past mid-September. PSC staff sampled sockeye from most test fishery catches and commercial fishery landings. Sampling locations included Port Renfrew and Greater Vancouver in British

²⁰ 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.

²¹ 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).

²² Gable, J. and S. Cox-Rogers. Stock identification of Fraser River sockeye salmon: methodology and management application. PSC Tech. Rep. No. 5, October, 1993.

Columbia, and Bellingham and Sekiu in Washington. DFO provided samples from test fisheries in Johnstone Strait and from in-river test fisheries at Albion and Qualark. The PSC contracted services to obtain samples from commercial troll samples in Johnstone Strait. Alaska's Department of Fish and Game (ADFG) 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 (formerly called the Queen Charlotte Islands). DFO and First Nations personnel obtained samples from Fraser River First Nations catches when available.

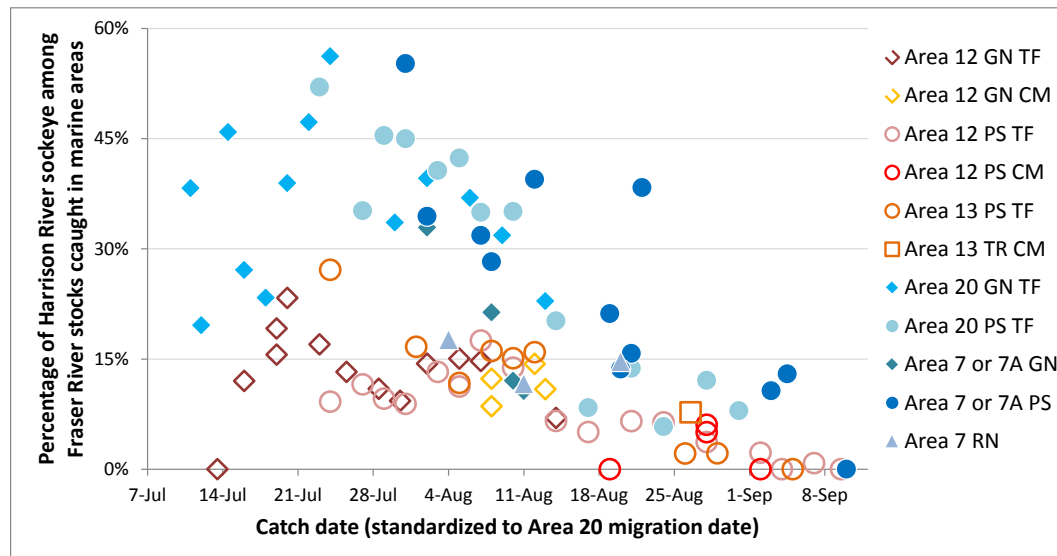
Two other notable samples were collected. In the first week of August, with permission from Cowichan Lands and Resources Management, an FSC catch in Area 18 was sampled by purse seiner Lloyd Baines. In the second week of September, PSC hydroacoustics staff collected samples from carcasses in the Fraser River near Mission. Both of these samples comprised higher fractions of Harrison River sockeye (age 4₁ and 3₁ scales) than were observed in other samples listed above. Figure H1a below presents estimates of Harrison proportions in samples from marine areas where fish are assumed to actively migrate, and Figure H1b presents estimates of Harrison proportions in samples from in-river fisheries for which the same assumption is made. The percentage of Harrison sockeye ranged up to 27% in catch samples from Johnstone Strait, 56% in Juan de Fuca Strait, and 56% in the Fraser River. Despite the high variance in Harrison proportions in samples of migratory fish, no sample comprised as high a fraction of Harrison as the 63% observed in the Area 18 FSC sample from early August or the 87% estimated in the en-route mortality sample near Mission. Thus, Harrison River sockeye stood out from other Fraser River stocks, suggesting that some early-returning Harrison fish may have delayed river entry, and a high proportion relative to co-migrating stocks died near Mission during the upstream migration.

Much of the variance seen in marine samples (Figure H1a) may be explained by a preference of adult Harrison sockeye, relative to other Fraser stocks, to migrate to the Fraser River via Juan de Fuca Strait (solid symbols in Figure H1a) rather than through Johnstone Strait (open symbols in Figure H1a). A similar difference in stock proportion estimates between the two approach routes was not detected among other Fraser sockeye stocks. There was considerable variation among in-river sample locations as well (Figure H1b), but the pattern of this variance was also observed for non-Harrison stocks. Ongoing research by Staff to understand the apparent differences in spatial distribution, gear vulnerabilities, or other potential violations of sampling assumptions within the lower river should result in improved catch and escapement estimates in the future.

One sampling issue unique to 2011 is suspected and is worth noting. Non-random sample collection may occur during catch, due to variance in catchability among stocks, and during sampling due to fish selection by the sampler. Because TAC was considerably more available for pink salmon than for sockeye salmon, a number of sockeye were returned to the ocean after being caught in some Canadian and US fisheries (i.e., sockeye non-retention). This introduced another potential opportunity for biasing samples, since sockeye that were visually less distinguishable from pink salmon (e.g., small sockeye), may have a higher chance of being kept and then sampled. (This was suspected after an Area 12 commercial purse seiner, confirmed to have been releasing sockeye, yielded a sockeye sample with a very low average body size and a relatively high frequency of individuals without adipose fins.) If the bias resulting from non-random sockeye release was strong, the stock composition estimate obtained would be representative of the kept sockeye, but would be representative of neither the stock mixture in the fishing area nor the released sockeye. If undetected and unaccounted for, this source of bias has implications for assigning release mortality (estimated at 35,000 in 2011) to stocks, and could potentially affect estimates of stock abundance and delay. This issue should be analysed further if a similar sockeye release strategy is to be employed in 2013.

Proportions of Fraser River sockeye in District 104 seine catches were estimated by DNA analyses in 2011. About 18,000 sockeye caught in District 104 were of Fraser origin.

(Fig. 1a)



(Fig. 1b)

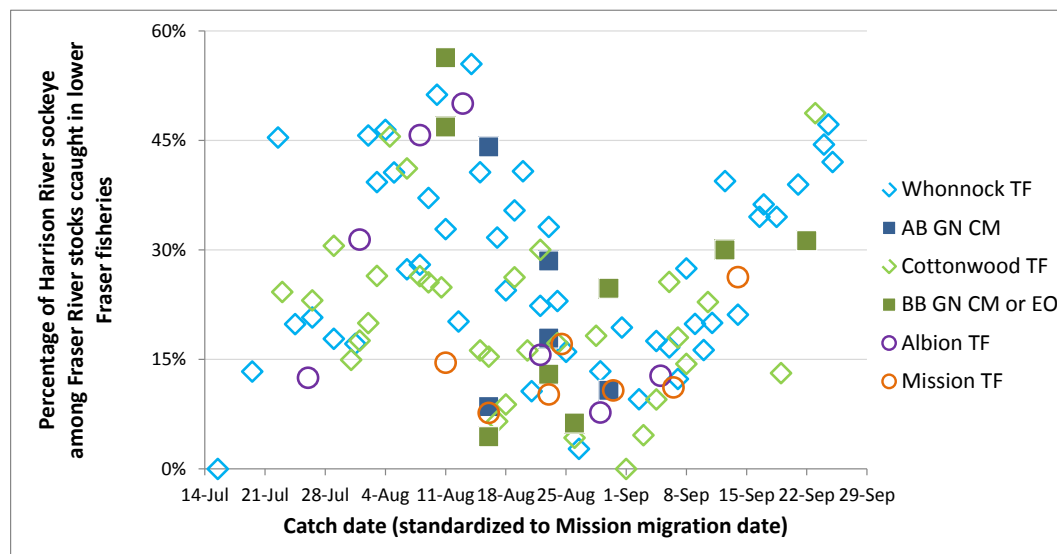


Figure H1. Percentages of Harrison River sockeye among Fraser River stocks in samples from (a) a variety of marine areas and (b) a variety of lower river areas. Fisheries sampled in (a) include Areas 12 and 13 (Johnstone Strait route), and Areas 20, 7 and 7A (Juan de Fuca Strait route) by gillnet (GN), purse seine (PS), troll (TR) and reefnet (RN) gear in test (TF), commercial (CM) and other fisheries. In some cases fishery types have been combined. All catch dates have been adjusted to approximate Area 20 date. In-river estimates in (b) include test fishery samples at Mission, Whonnock, Albion and Cottonwood, and also samples from commercial fisheries upstream of the Pattullo Bridge (AB CM) and commercial and economic opportunity fisheries downstream of the Pattullo Bridge (BB CM or EO). All catch dates have been adjusted to approximate Mission date.

B. Pink Salmon

Pink salmon mixtures are apportioned into three components - Fraser, Canada South Coast (excluding Fraser) and Washington. The ability to accomplish this level of stock resolution is based on a database of genetic information (i.e., baseline) from numerous stocks from each region. In 2011, the baseline comprised 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; (2) Canada

South Coast – Quatse, Cluxewe, Wakeman, Adam, Kakweiken, Glendale, Klinaklini, Lull, Heydon, Big Qualicum, Keogh, Nanaimo, Quinsam, Puntledge, Ahta, Salmon, Oyster, Squamish and Indian; and (3) Washington – Nooksack, Skagit, Stillaguamish, Snohomish, Green, Puyallup, Hamma, Duckabush, Dosewallips, Dungeness, Hood Canal and Nisqually. The stocks in this baseline represent most of the pink salmon stocks that could contribute to marine fishery catches where Fraser pinks are typically harvested. Note that pink salmon populations within a region tend to be less genetically differentiated than sockeye populations. The ability for Staff to confidently resolve pink salmon into component sub-stocks is therefore limited compared to sockeye salmon.

In 2011, tissue samples from up to 100 pink salmon were collected at approximately weekly intervals from particular fisheries. DNA sampling and analysis was similar to previous years with the following changes: adipose fin tissue (rather than opercular tissue) was collected, 16 microsatellite loci were genotyped (versus 14 previously), and genotypic data were compared to 46 baseline stocks (compared to 31 in 2009) using the program ONCOR²³ (instead of SPAM). Stock composition estimates derived from these analyses were used to assess catch, migration route (diversion rate) and run size of Fraser pinks.

DNA results were obtained for Canadian statistical Areas 12, 13 and 20, and U.S. Areas 7 and 7A from early August to early September. Estimated proportions of Fraser River pink salmon in these samples are presented in Figure H2. Proportions of Fraser pinks in Johnstone Strait samples increased from about 15% in early August to 80-90% by early September, and in Area 20 samples increased from about 20% at the beginning of August to 60% in early September, but with an apparent peak in late August. In U.S. Areas 7 and 7A, the contribution of Fraser pinks ranged from about 70% to 90% from late August to early September. These results are broadly consistent with observations in previous years.

The pink salmon DNA program developed rapidly and has continued to evolve. Foreseeable changes in the future are expected to be refinements rather than the major developments that have characterized progress to date.

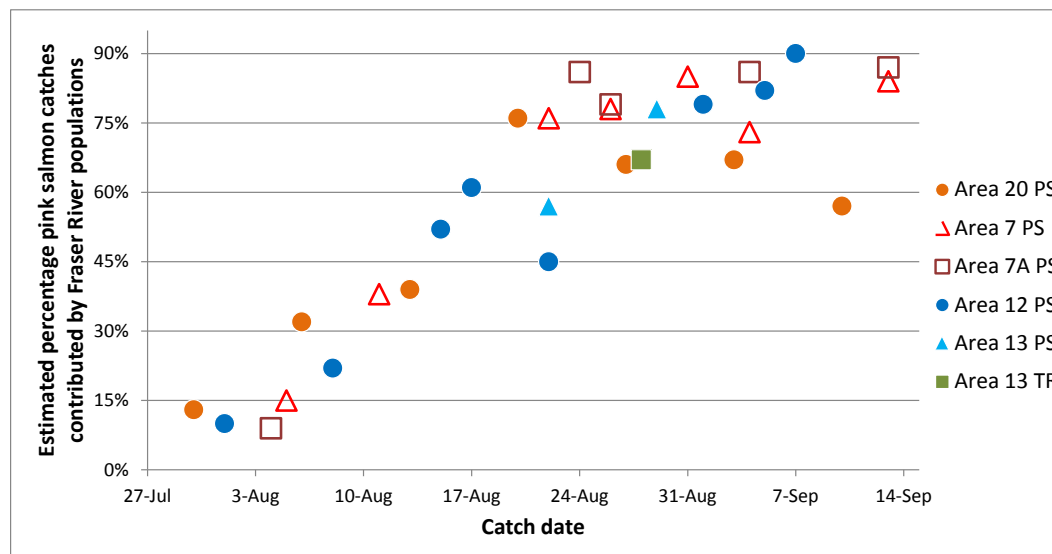


Figure H2. Percentages of Fraser River pink salmon in commercial and test purse seine (PS) and troll (TR) fishery samples from Areas 12, 13, 20, 7 and 7A. Dates are approximate catch dates unadjusted for migration.

²³ 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> (January 2012).

Stock Assessment

Assessment of Fraser River sockeye abundance by stock group is primarily based on catch, effort, escapement and stock composition data. Even though sockeye catches totalled more than 1.7 million salmon in 2011, stock assessment methods relied mainly on catch and CPUE data from test fishing vessels to assess abundances by stock group. Data from other types of fisheries are not as useful because they occur in locations such as the Fraser River (almost half of the 1.7 million harvest) and thus do not provide timely-enough information, or the historical harvest pattern has been too irregular to be useful for assessment of abundance (e.g., Canadian ITQ fisheries in recent years). Test fishery data are analysed using Bayesian stock assessment models^{24, 25}, in which reconstructed daily migration patterns are compared 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 about the run size because the fraction of the run that has been observed cannot be accurately estimated. Based on initial observations before the peak of the run, the estimates can indicate the run to be either earlier or smaller than forecast, or later and larger than forecast. The uncertainty about the actual size of the run is estimated using the Bayesian methodology. The Bayesian version of the cumulative normal model relies on additional information (i.e., pre-season forecasts of run size based on historical stock-recruit data, 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.

Figures H3a, b, c, d, e and f provide an overview of run-size estimates from the stock assessment model at various dates during the season (median and 80% probability interval). These estimates can be compared against the official in-season run-size estimates used for management purposes (Table 1 in body of report) and against the final in-season estimates of the accounted run-to-date. For all stocks, pre-season forecasts underestimated the run size. In-season, the pre-season forecast of earlier than normal migration timing combined with the initial shape of the run indicated smaller run sizes for the various stocks than were accounted for at the end of the season. The observed later timing of the run and the multimodal run shape caused the run-size estimate to gradually increase as the season progressed.

It is important to note that although virtually all run-size estimates shown in Figure H3 were reported to the Panel or Technical Committee during the in-season meetings, they were not always associated with formal recommendations by PSC staff. Staff generally do not recommend run-size changes prior to observing the peak of the run, or if a new estimate is similar to the current adopted estimate. The Panel usually adopts Staff run-size recommendations, however, so the pattern of Panel-adopted run sizes follows that of Staff recommendations.

²⁴ 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.

²⁵ 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.

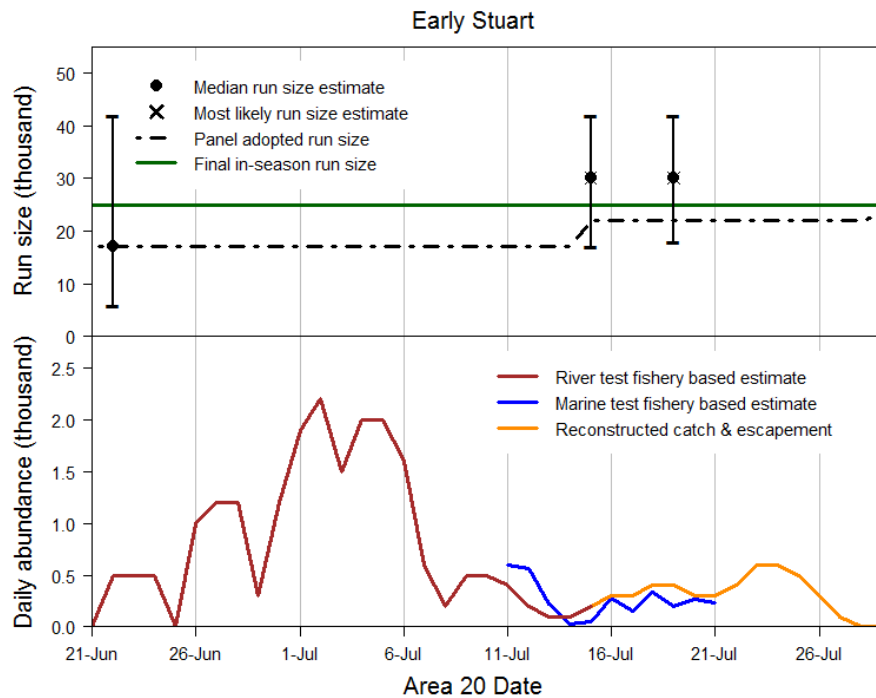


Figure H3a. Daily reconstructed abundance estimates for Early Stuart sockeye and corresponding run-size estimates at different times during the season.

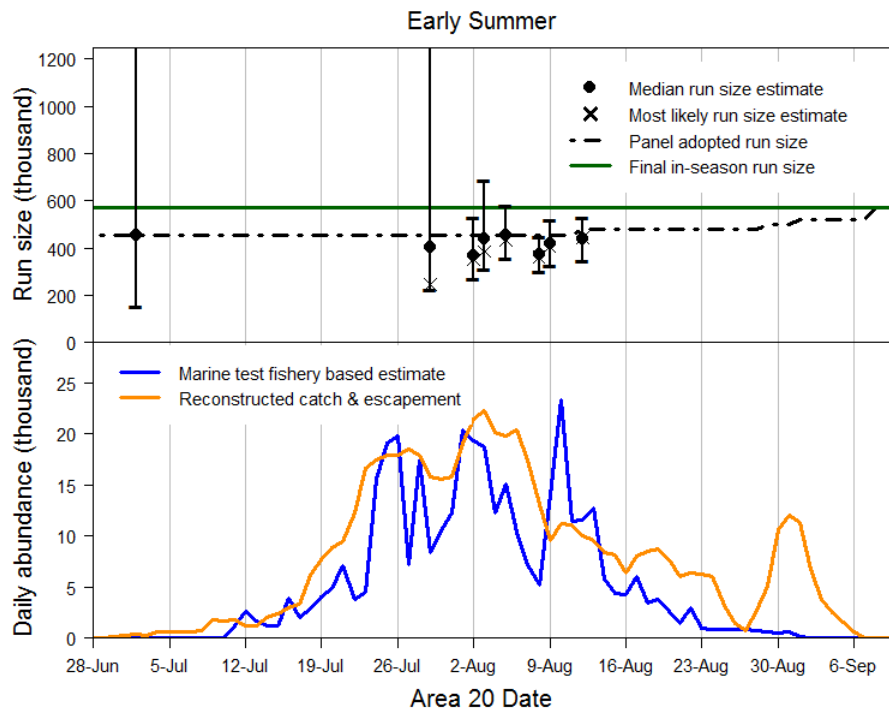


Figure H3b. Daily reconstructed abundance estimates for Early Summer-run sockeye and corresponding run-size estimates at different times during the season.

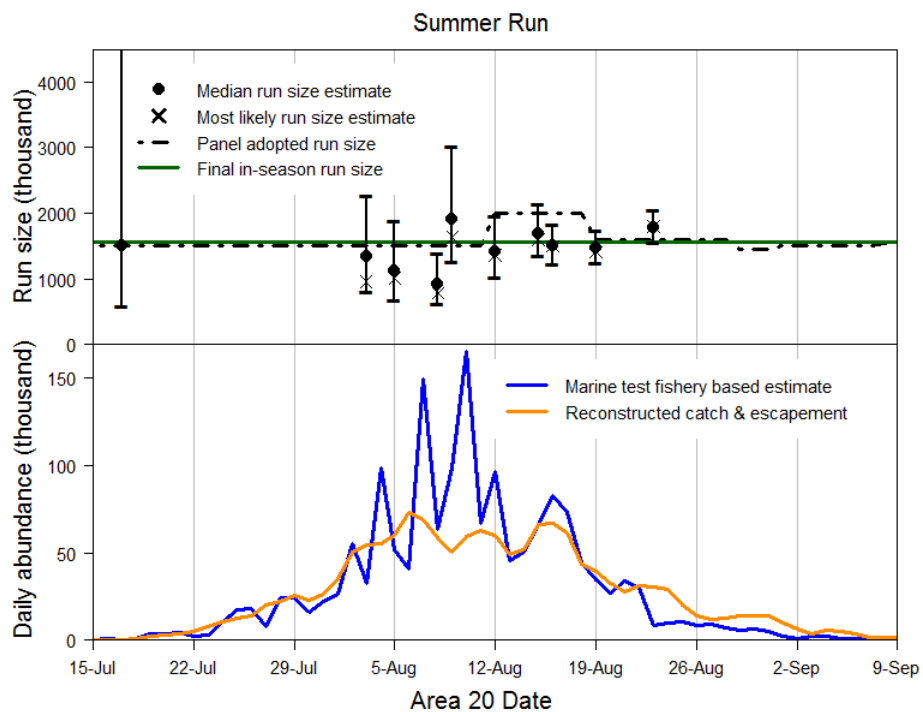


Figure H3c. Daily reconstructed abundance estimates for Summer-run sockeye and corresponding run-size estimates at different times during the season.

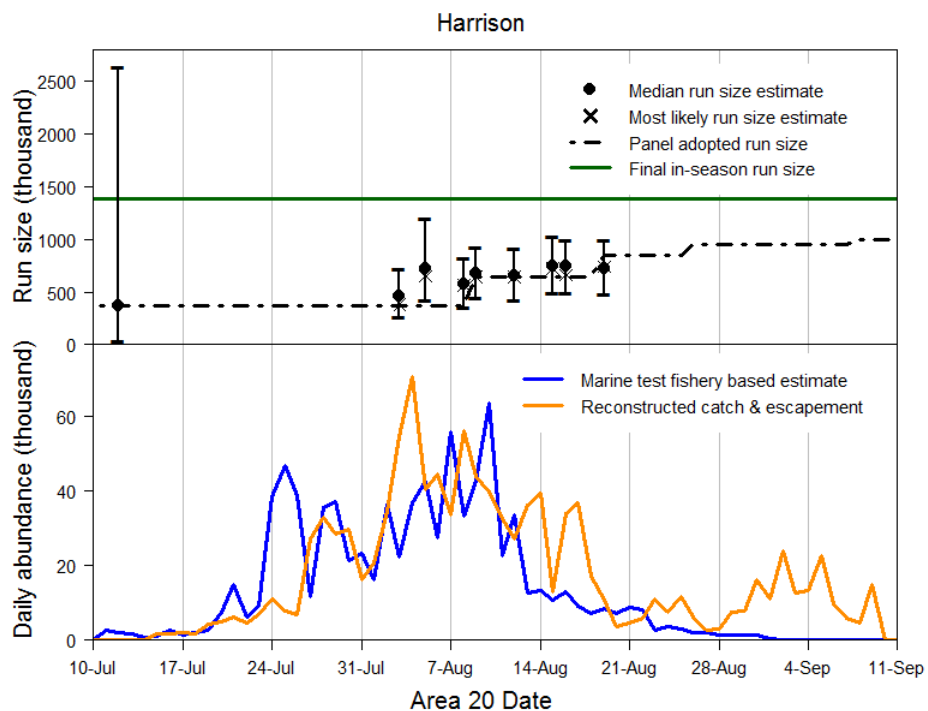


Figure H3d. Daily reconstructed abundance estimates for Harrison sockeye and corresponding run-size estimates at different times during the season.

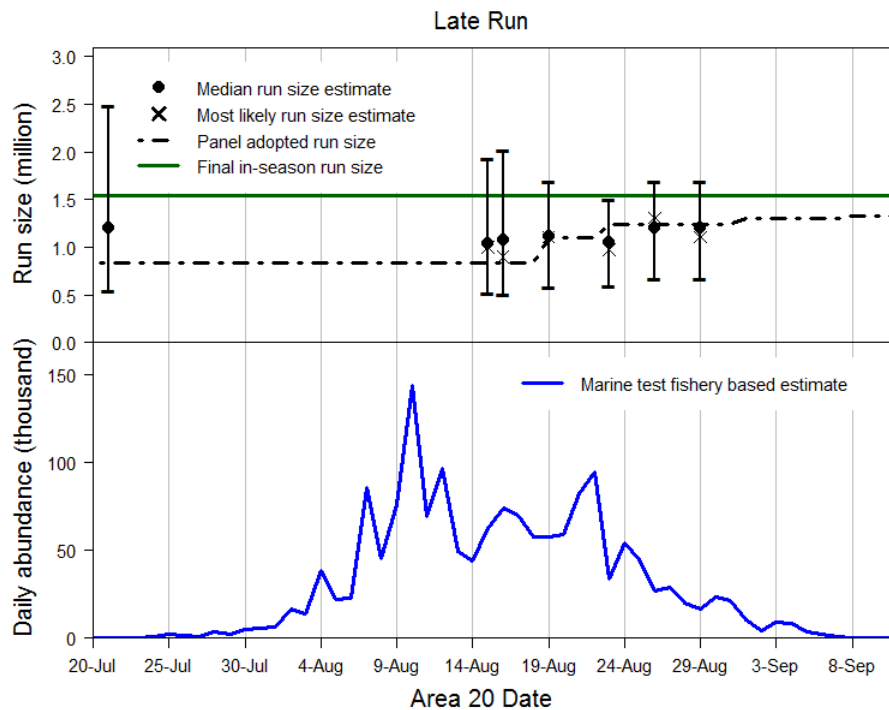


Figure H3e. Daily reconstructed abundance estimates for Late-run sockeye and corresponding run-size estimates at different times during the season.

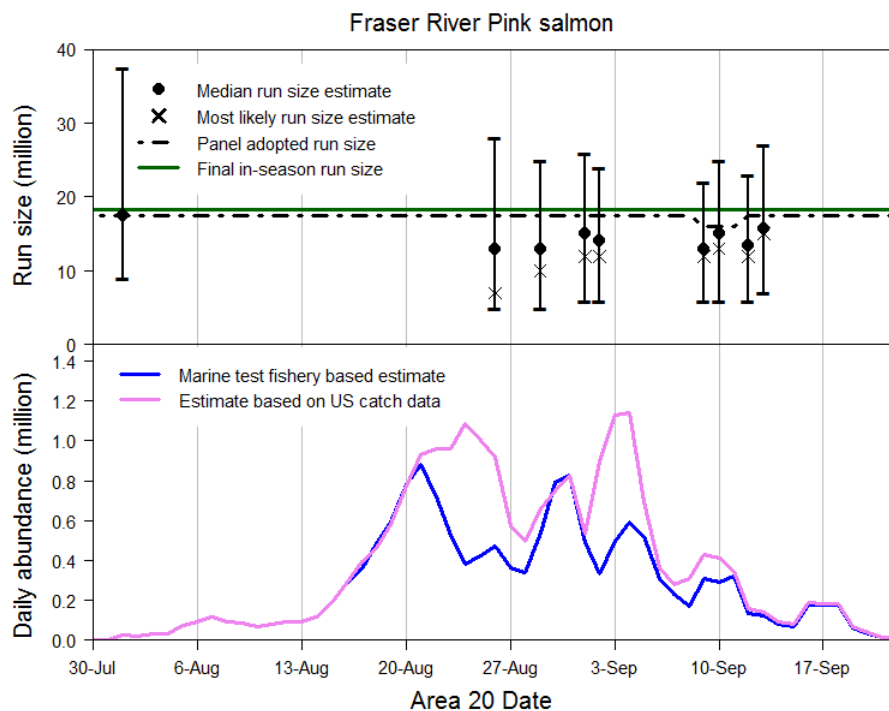


Figure H3f. Daily reconstructed abundance estimates for Fraser River pink salmon and corresponding run-size estimates at different times during the season.

Management Adjustment and DBE

A rigorous assessment of alternative Early Summer and Late-run MA models was performed during the pre-season and in-season periods in response to requests from the Panel. Given the diversity in migration timing and exposure to environmental conditions of various Early Summer

stocks, Staff examined the rationale for four alternative Early Summer MA models that fit relationships to varying subsets of the historical DBE and environmental datasets: (1) All years, (2) 2010/2011 cycle lines (i.e., cycles with traditionally high relative abundance of Scotch-Seymour stocks), (3) 2008/2009 cycle lines (i.e., cycles with relatively low abundance of Scotch-Seymour stocks), and (4) the 2011 (i.e., current) cycle line. After consideration of the Staff's analyses, the Panel adopted the all-years Early Summer model for pre-season and in-season MA forecasts (Table H2, below). Temperature plus discharge MA models were applied to Early Stuart, Early Summer and Summer runs both pre-season and in-season.

Staff also evaluated alternative Late-run MA models fit to historical datasets that included or excluded various Late-run stocks: (1) All Lates combined (i.e., Harrison, Birkenhead, Lates), (2) Harrison, (3) Birkenhead, (4) Lates excluding Birkenhead, and (5) Lates excluding Harrison. Within these stock combinations, Staff also considered models fit to subsets of data corresponding to various cycle lines. No significant model fit was observed between historical DBEs and Mission 50% dates for the Harrison or Birkenhead stocks. Including these two stocks in the Late-run component therefore weakened the fit of the Late-run MA model.

While all Late-run stocks were pooled for pre-season planning, in-season (Table H2) the Panel adopted an approach that used a fixed MA for Harrison (pMA = 0.38, median since 2004 excluding 2006 and 2010) and the following rule for non-Harrison Late runs (i.e., Birkenhead, Adams, Weaver, Portage and Cultus): *The pre-season pMA value of 0.69 is to be applied unless the Panel is confident that the upstream timing of the Adams/Weaver/Birkenhead group will be August 29 or later. The in-season calculations will apply if the predicted upstream timing for the Adams/Weaver/Birkenhead group is August 29 or later.* The Mission 50% date for the Adams/Weaver/Birkenhead group was predicted from Adams/Weaver upstream timing, which in turn was predicted from the proportion of Adams/Weaver observed upstream-to-date. The MA was then predicted from the estimated Mission 50% date for the Adams/Weaver/Birkenhead group.

Table H2. Summary of the pre-season and in-season MA models and assumptions used during 2011 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 (under Panel Management Activities) of the report.

Management Group	Pre-season				In-season			
	Predictor variables	Upstream 50% Date ¹	Cycle lines	Excluded years	Predictor variables	Upstream 50% Date	Cycle lines	Excluded years
Early Stuart	31-day temp and discharge ²	10-Jul	All	1977, 1980, 1982, 1984, 1986	19-day temp and discharge ²	13-Jul	All	1977, 1980, 1982, 1984, 1986
Early Summer	31-day temp and discharge	10-Aug	All	1993	19-day temp and discharge	11-Aug	All	1993
Summer	31-day temp and discharge	17-Aug	All	2002	19-day temp and discharge	20-Aug	All	2002
Harrison	NA	NA	NA	NA	No model used. pMA equivalent to the median of 2005, 2007, 2008, 2009	NA	All	2006, 2010
Late ³	No model used. pMA equivalent to the median of 1999, 2003, 2007 (i.e., 3 most recent years on 2011 cycle line)	27-Aug	2011	NA	Mission 50% Date	9-Sep	2010/2011	1977, 1979, 1980, 1981, 1983, 1984, 1985, 1987, 1988, 1989, 1991, 1992, 1993, 1995, 2006, 2010

¹ Hells Gate timing for Early Stuart, Early Summer and Summer runs. Mission timing for Late runs.

² $\ln(\text{DBE}) = a + b_1T + b_2T^2 + b_3Q + b_4Q^2$ where $T = 31\text{-day}$ (or 19-day ; 15-days before , 3-days after) temperature centred on the Hells Gate 50% date and $Q = 31\text{-day}$ (19-day) discharge.

³ Pre-season definition of Lates included Adams/Weaver/Birkenhead/Harrison. In-season definition of Lates included Adams/Weaver/Birkenhead.

APPENDIX I: HISTORICAL CATCH, ESCAPEMENT AND PRODUCTION DATA

Table I1. Catch by user group, spawning escapement, run-size adjustment and run size of Fraser River sockeye salmon for cycle years 1999-2011.

	Fraser Sockeye Salmon			
	1999	2003	2007	2011
CANADIAN CATCH	422,000	1,929,000	199,200	1,439,100
Commercial	49,000	1,036,000	0	449,200
Panel Area	1,000	266,000	0	160,800
Non-Panel Areas	48,000	770,000	0	207,200
First Nations EO & Demo	0	0	0	81,200
First Nations FSC	347,000	805,000	196,900	850,100
Marine	95,000	218,000	42,900	265,300
Fraser River	252,000	587,000	154,000	584,800
Non-commercial	26,000	88,000	2,300	139,800
Marine Recreational	2,000	3,000	200	17,300
Fraser Recreational	14,000	74,000	0	84,300
Charter	4,000	1,000	0	4,200
ESSR	6,000	10,000	2,100	33,900
UNITED STATES CATCH	41,000	311,000	142,400	297,200
Washington Total	20,000	243,000	3,400	278,800
Commercial	20,000	243,000	0	265,900
Treaty Indian	20,000	159,000	0	181,000
All Citizen	0	84,000	0	84,900
Non-commercial	0	0	3,400	12,900
Ceremonial	0	0	3,400	12,900
Recreational	0	0	0	0
Alaska	21,000	68,000	139,000	18,400
TEST FISHING CATCH	99,000	107,000	34,800	40,400
PSC (Panel Areas)	53,000	41,000	21,800	26,500
Canada	53,000	40,000	13,400	24,700
United States	0	1,000	8,400	1,700
Canada (non-Panel Areas)	46,000	66,000	13,000	14,000
TOTAL RUN	3,675,800	4,898,000	1,510,300	5,130,100
Total Catch in All Fisheries	562,000	2,347,000	376,400	1,776,800
Adult Spawning Escapement	1,865,300	1,979,400	887,100	2,580,100
Jack Spawning Escapement	2,500	8,600	1,900	6,500
Run-size Adjustment	1,246,000	563,000	244,900	766,800
Percentage of Total Run	100%	100%	100%	100%
Total Catch in All Fisheries	15%	48%	25%	35%
Adult Spawning Escapement	51%	40%	59%	50%
Jack Spawning Escapement	0%	0%	0%	0%
Run-size Adjustment	34%	11%	16%	15%

Table I2. Catch by user group, spawning escapement and run size of Fraser River pink salmon for cycle years 2005-2011.

	Fraser Pink Salmon			
	2005	2007	2009	2011
CANADIAN CATCH	637,400	406,100	1,726,800	4,931,000
Commercial	336,800	311,200	1,423,500	4,748,400
Panel Area	1,100	0	75,100	797,700
Non-Panel Areas	124,200	1,900	840,400	2,959,500
First Nations EO & Demo	211,500	309,300	508,000	991,300
First Nations FSC	236,200	17,600	12,500	59,000
Marine	182,500	5,900	10,500	21,600
Fraser River	53,700	11,700	2,000	37,400
Non-commercial	64,400	77,200	290,800	123,600
Marine Recreational	47,000	59,200	38,600	63,200
Fraser Recreational	17,400	18,000	237,200	55,300
Charter	0	0	2,700	1,200
ESSR	0	0	12,300	3,800
UNITED STATES CATCH	338,400	395,100	2,815,600	2,916,500
Washington Total	338,400	395,100	2,815,600	2,916,500
Commercial	316,800	368,200	2,793,600	2,901,500
Treaty Indian	182,700	210,100	1,031,400	1,403,800
All Citizen	134,100	158,100	1,762,200	1,497,700
Non-commercial	21,600	26,900	22,000	15,000
Ceremonial	100	400	1,000	13,800
Recreational	21,500	26,500	21,000	1,200
Alaska	0	0	0	0
TEST FISHING CATCH	84,600	38,800	21,800	13,100
PSC (Panel Areas)	13,900	25,100	18,300	11,900
Canada	13,500	23,600	12,500	9,300
United States	500	1,600	5,800	2,600
Canada (non-Panel Areas)	70,700	13,700	3,500	1,200
TOTAL RUN	10,000,000	11,000,000	19,993,000	20,649,000
Total Catch in All Fisheries	1,060,400	839,900	4,564,200	7,860,600
Adult Spawning Escapement	8,939,600	10,160,100	15,428,800	12,788,400
Percentage of Total Run	100%	100%	100%	100%
Total Catch in All Fisheries	11%	8%	23%	38%
Adult Spawning Escapement	89%	92%	77%	62%

Table I3. Fraser River sockeye salmon catch in Canadian First Nations fisheries by area for cycle years 1999-2011.*

Fishing Area	1999	2003	2007	2011
Fraser River	252,400	586,900	154,000	666,000
Fraser River Mainstem	223,200	545,200	136,200	540,400
Below Port Mann	26,200	114,900	14,300	128,300
Port Mann to Mission	15,800	88,800	14,900	81,700
Mission to Hope	26,600	66,600	19,700	78,700
Hope to Sawmill Cr.	69,800	153,600	24,000	120,500
Sawmill Cr. to Kelly Cr.	72,800	114,000	56,500	116,900
Kelly Creek to Prince George	8,700	5,100	2,700	7,500
Above Prince George	3,300	2,200	4,100	6,700
Tributaries	29,200	41,700	17,800	125,600
Harrison/Lillooet System	n/a	n/a	n/a	52,219
Thompson System	2,600	8,700	2,000	16,100
Chilcotin System	19,800	29,600	11,700	53,900
Nechako System	3,000	0	3,000	2,200
Stuart System	3,800	3,400	1,100	1,300
Marine Areas	95,100	217,500	42,900	265,300

* Data supplied by DFO.

Table I4. Fraser River pink salmon catch in Canadian First Nations fisheries by area for cycle years 2005-2011.*

Fishing Area	2005	2007	2009	2011
Fraser River	263,500	321,100	510,000	1,028,700
Fraser River Mainstem	263,100	320,800	509,600	1,018,600
Below Port Mann	15,300	4,000	39,200	109,300
Port Mann to Mission	5,000	1,500	200	64,000
Mission to Hope	221,900	312,200	469,800	842,400
Hope to Sawmill Cr.	6,300	1,600	200	1,600
Sawmill Cr. to Kelly Cr.	14,600	1,300	200	1,100
Kelly Creek to Prince George	0	0	0	100
Above Prince George	0	0	0	200
Tributaries	400	200	300	10,000
Harrison/Lillooet System	0	0	0	0
Thompson System	400	100	0	10,000
Chilcotin System	0	200	300	0
Nechako System	0	0	0	0
Stuart System	0	0	0	0
Marine Areas	182,500	5,900	10,500	21,600

* Data supplied by DFO.

Table I5. Escapements of sockeye salmon to Fraser River spawning areas for cycle years 1999-2011.

DISTRICT		Year			
	<u>Stock Group</u>				
	Stream/Lake	1999	2003	2007	2011
NORTHEAST					
	Upper Bowron R.	8,238	6,752	2,173	4,101
STUART					
	<u>Early Stuart</u>				
	Driftwood R.	183	425	97	12
	Takla L. Streams	4,004	3,070	881	229
	Middle R. Streams	16,009	7,561	3,735	415
	Trembleur L. Streams	4,342	2,100	634	101
	<u>Late Stuart</u>				
	Kazchek Cr.	106	115	22	16
	Kuzkwa Cr.	4,318	1,578	1,318	569
	Middle R.	8,559	3,851	835	564
	Tachie R.	44,273	26,899	4,499	2,318
	Miscellaneous	4,318	4,204	1,813	316
NECHAKO					
	Nadina R. (Late)	3,239	1,557	497	3,535
	Nadina Channel	7,099	1,606	1,244	6,521
	Stellako R.	138,137	78,093	41,328	85,174
QUESNEL					
	Horsefly R.	133,942	155,564	55,919	29,952
	Horsefly Channel	5,974	22,965	3,628	2,362
	McKinley Cr.	943	3,748	1,245	72
	Mitchell R.	46,451	90,779	9,880	11,558
	Miscellaneous	2,050	6,114	4,428	1,527
CHILCOTIN					
	Chilko R. & L.	891,567	608,321	305,853	916,643
	Chilko Channel	0	0	0	0
	Taseko L.	1,160	380	233	964
SETON-ANDERSON					
	Gates Cr.	88	880	0	38,153
	Gates Channel	4,047	8,931	2,555	17,707
	Portage Cr.	6,264	4,940	1,699	1,114
NORTH THOMPSON					
	North Thompson R.	2	26,004	18,142	4,929
	Raft R.	6,979	10,040	14,353	9,241
	Fennell Cr.	5,710	9,218	11,403	9,988
SOUTH THOMPSON					
	<u>Early Summer-run</u>				
	Scotch Cr.	4,093	5,089	8,272	33,807
	Seymour R.	18,895	31,345	9,979	16,456
	Upper Adams / Momich / Cayenne	69	371	232	552
	Miscellaneous	6,124	5,044	6,313	15,508
	<u>Late-run</u>				
	Adams R.	314,416	355,866	52,792	148,175
	Little R.	19,345	15,647	1,937	3,956
	Lower Shuswap R.	7,081	5,767	5,427	11,068
	Miscellaneous	2,698	3,998	887	2,496
HARRISON-LILLOOET					
	Birkenhead R.	48,916	309,878	93,480	227,742
	Big Silver Cr. & misc. Birk. types	845	14,174	5,020	16,942
	Harrison R.	8,577	8,259	128,295	805,596
	Weaver Cr.	13,520	14,452	10,969	26,938
	Weaver Channel	21,114	35,036	26,331	45,631
LOWER FRASER					
	Nahatlatch R. & L.	2,613	3,070	3,853	6,955
	Cultus L.	12,392	2,184	689	7,201
	Upper Pitt R.	35,961	78,229	41,829	55,997
	Chilliwack L./Dolly Varden Cr.	424	4,956	1,965	4,479
MISCELLANEOUS		207	325	455	1,844
ADULTS		1,865,292	1,979,385	887,139	2,579,424
JACKS		2,479	8,575	1,908	6,464
TOTAL NET ESCAPEMENT		1,867,771	1,987,960	889,047	2,585,888

* Estimates are from DFO.

1 Cultus estimates include 245 sockeye in 2003, 151 in 2007 and 253 in 2011 removed for broodstock.

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

Table I6. Fraser River pink salmon production for odd brood years in 1961-2009 (return years 1963-2011).

Brood Year	Spawners		Potential	Fry	Adult Returns		% Survival		Average To Date
	Total	Female	Egg	Production	(Catch +	Escapement)	Fresh	Marine	
	(millions)	(millions)	Deposition	(millions)	(millions)		Water		
(by)	(by)	(by)	(by)	(by+1)	(by+2)				
1961	1.092	0.654	1,569	143.6	5.482		9.2%	3.8%	3.8%
1963	1.954	1.216	2,435	284.2	2.320		11.7%	0.8%	2.3%
1965	1.194	0.692	1,488	274.0	12.963		18.4%	4.7%	3.1%
1967	1.831	0.973	2,132	308.0	3.931		14.4%	1.3%	2.7%
1969	1.531	0.957	2,018	287.7	9.763		14.3%	3.4%	2.8%
1971	1.805	1.096	1,923	273.6	6.801		14.2%	2.5%	2.8%
1973	1.754	1.009	1,865	212.3	4.894		11.4%	2.3%	2.7%
1975	1.367	0.781	1,493	319.7	8.209		21.4%	2.6%	2.7%
1977	2.388	1.362	2,960	483.7	14.404		16.3%	3.0%	2.7%
1979	3.561	2.076	3,787	341.3	18.685		9.0%	5.5%	3.0%
1981	4.488	2.560	4,814	607.0	15.346		12.6%	2.5%	2.9%
1983	4.632	2.931	4,702	557.4	19.038		11.9%	3.4%	3.0%
1985	6.461	3.561	5,900	264.5	7.172		4.5%	2.7%	3.0%
1987	3.224	1.856	3,471	436.0	16.484		12.6%	3.8%	3.0%
1989	7.189	4.383	7,198	400.4	22.174		5.6%	5.5%	3.2%
1991	12.943	8.002	12,330	685.5	16.983		5.6%	2.5%	3.1%
1993	10.768	6.454	9,192	437.7	12.904		4.8%	2.9%	3.1%
1995	7.175	4.248	10,233	279.1	8.176		2.7%	2.9%	3.1%
1997	2.842	1.740	2,863	257.5	3.608		9.0%	1.4%	3.0%
1999	3.445	1.885	2,702	219.0	21.262		8.1%	9.7%	3.4%
2001	19.814	9.543	16,274	714.4	24.250		4.4%	3.4%	3.4%
2003	n/a	n/a	n/a	419.0	9.870	¹	n/a	2.4%	3.3%
2005	n/a	n/a	n/a	614.5	8.490	¹	n/a	1.4%	3.2%
2007	n/a	n/a	n/a	497.0	19.936	¹	n/a	4.0%	3.3%
2009	15.429	n/a	n/a	1062.4	20.649		n/a	1.9%	3.2%
Average	5.313	2.761	4,826	415.2	12.552		10.6%	3.2%	

¹ 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.

Table 17. Detailed calculation of total allowable catch (TAC) and achievement of international catch shares for Fraser sockeye (by management group) and pink salmon in 2011. 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 8), in accordance with Annex IV of the Treaty and the February 17, 2011 Commission Guidance.

	Fraser Sockeye							Fraser Pinks
	Early Stuart	Early Summer	Summer	Harrison	Late	Total		
RUN STATUS, ESCAPEMENT NEEDS & AVAILABLE SURPLUS								
In-season Abundance Estimate	25,000	571,000	1,556,000	1,381,000	1,544,000	5,077,000		18,300,000
Adjusted Spawning Escapement Target *	25,000	317,500	622,400	762,300	833,800	2,560,900		6,000,000
Spawning Escapement Target (SET)	25,000	228,400	622,400	552,400	617,600	2,045,800		6,000,000
%SET from TAM rules	100%	40%	40%	40%	40%			0
Management Adjustment (MA)	102,500	89,100	0	209,900	216,200	617,600		n/a
Proportional MA (pMA)	4.10	0.39	0	0.38	0.35			
Test Fishing Catch (TF, post-seas. est.)	200	7,000	13,600	9,700	9,900	40,400		13,100
Surplus above Adjusted SET & TF	0	246,500	920,000	609,000	700,300	2,475,800		12,286,900
DEDUCTIONS & TAC FOR INTERNATIONAL SHARING								
Aboriginal Fishery Exemption (AFE) **	2,000	46,700	259,800	27,500	64,100	400,000		n/a
Total Deductions (Adj.SET + TF + AFE)	27,100	371,200	895,800	799,500	907,800	3,001,400		6,013,100
Available TAC (Abundance - Deductions)	0	199,800	660,200	581,500	636,200	2,077,800		12,286,900
UNITED STATES (Washington) TAC								
Propor. distrib. TAC - Payback	0	33,000	108,900	95,900	105,000	342,800		3,157,700
Proportionally distributed TAC ***	0	33,000	108,900	95,900	105,000	342,800	16.5%	3,157,700 25.7%
U.S. Payback	0	0	0	0	0	0		0
Washington Catch	0	15,200	104,400	73,100	86,000	278,800		2,916,500
Deviation from TAC - Payback	0	17,800	4,500	22,800	18,900	64,000		241,300
CANADIAN TAC								
Propor. distrib. TAC + Payback + AFE	2,000	213,600	811,100	513,000	595,300	2,134,900		9,129,100
Propor. distrib. TAC + U.S. Payback	0	166,900	551,300	485,600	531,200	1,734,900	83.5%	9,129,100 74.3%
AFE	2,000	46,700	259,800	27,500	64,100	400,000		0
Canadian Catch excluding ESSR Catch	2,000	178,500	710,700	202,500	311,500	1,405,200		4,931,000
Deviation from TAC + Payback + AFE	-100	35,000	100,400	310,500	283,900	729,700		4,198,100
TOTAL								
Available TAC + U.S. Payback + AFE	2,000	246,500	920,000	609,000	700,300	2,477,800		12,286,900
Total Catch excluding ESSR Catch	2,000	193,700	815,100	275,600	397,500	1,684,000		7,847,500
Deviation from TAC + U.S. Payback + AFE	-100	52,800	104,900	333,300	302,800	793,800		4,439,400

* The adjusted spawning escapement target cannot exceed the estimated abundance.

** The AFE was adjusted to account for the actual catch of Early Stuart sockeye.

*** Washington sockeye and pink shares according to Annex IV of the Pacific Salmon Treaty and the February 17, 2011 Commission Guidance to the Fraser River Panel.

APPENDIX J: MEMBERS OF THE FRASER RIVER PANEL TECHNICAL COMMITTEE IN 2011

Canada	United States
A. Huang, Co-Chair <i>Fisheries and Oceans Canada</i>	G. Graves, Co-Chair <i>Northwest Indian Fisheries Commission</i>
S. Grant <i>Fisheries and Oceans Canada</i>	P. Mundy <i>National Marine Fisheries Service</i>
J. Scroggie <i>Fisheries and Oceans Canada</i>	S. Thiesfeld <i>Washington Department of Fish and Wildlife</i>
M. Staley <i>First Nations Advisor</i>	

APPENDIX K: STAFF OF THE PACIFIC SALMON COMMISSION IN 2011

EXECUTIVE OFFICE

Don Kowal, Executive Secretary
Scott Allen, Information Technology Manager
Kimberly Bartlett, Secretary/Receptionist
Sandie Gibson, Information Technology Support Specialist
Vicki Ryall, Meeting Planner
Teri Tarita, Records Administrator/Librarian

FINANCE AND ADMINISTRATION

Ken Medlock, Controller
Bonnie Dalziel, Accountant
Angus Mackay, Manager, Restoration & Enhancement Funds
Victor Keong, Program Assistant, Restoration & Enhancement Funds

FISHERIES MANAGEMENT DIVISION

Mike Lapointe, Chief Biologist

QUANTITATIVE ASSESSMENT GROUP

Catherine Michielsens, Quantitative Fisheries Scientist
Merran Hague, Quantitative Fisheries Biologist

STOCK IDENTIFICATION GROUP

Ian Guthrie, Head
Holly Anozie, Scale Analyst (Acting)
Catherine Ball, Scale Lab Assistant (Term)
Maxine Forrest, Senior Scale Analyst
Steve Latham, Sockeye Stock Identification Biologist
Julie Sellars, Senior Scale Analyst (Acting)
Bruce White, Pink Stock Identification Biologist

STOCK MONITORING GROUP

Jim Cave, Head
Keith Forrest, Test Fishing Biologist
Fiona Martens, Senior Hydroacoustic Technician
Jacqueline Nelitz, Hydroacoustic Technician
Yunbo Xie, Hydroacoustic Scientist