
**Report of the
Fraser River Panel
to the
Pacific Salmon Commission
on the
2010 Fraser River Sockeye
Salmon Fishing Season**



Prepared by the

**Pacific Salmon Commission
December 2015**

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**REPORT OF THE
FRASER RIVER PANEL
TO THE PACIFIC SALMON COMMISSION
ON THE 2010 FRASER RIVER SOCKEYE
SALMON FISHING SEASON**

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TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	ii
LIST OF FIGURES	iii
I. EXECUTIVE SUMMARY	1
II. FRASER RIVER PANEL	3
III. PANEL MANAGEMENT ACTIVITIES	4
A. Pre-season Planning.....	5
B. In-season Management.....	7
IV. MANAGEMENT INFORMATION	14
A. Abundance.....	15
B. Migration Timing and Diversion Rate.....	17
C. Management Adjustments and DBEs.....	18
D. Mission Escapement.....	20
V. RUN SIZE, CATCH AND SPAWNING ESCAPEMENT	21
VI. ACHIEVEMENT OF OBJECTIVES	28
A. Escapement.....	28
B. International Allocation.....	30
C. Domestic Allocation.....	31
D. Conservation of Other Stocks and Species.....	31
VII. ALLOCATION STATUS	32
VIII. APPENDICES	33
Appendix A: Glossary of Terms and Abbreviations.....	33
Appendix B: 2010 Pre-season Forecasts and Spawning Escapement Targets for Fraser River Sockeye and Pink Salmon.....	36
Appendix C: Commission Guidance to the Fraser River Panel for 2010.....	38
Appendix D: 2010 Fraser River Panel Management Plan Principles and Constraints.....	40
Appendix E: Guidelines for Pre-season Fraser Sockeye Fishing Plans to Address Late-Run Concerns.....	41
Appendix F: 2010 Regulations.....	42
Appendix G: 2010 Fraser River Panel In-Season Orders.....	44
Appendix H: PSC Stock Monitoring, Identification, Assessment and Management Adjustment Programs.....	49
Appendix I: Historical Catch, Escapement and Production Data, and Detailed 2010 TAC Calculation.....	59
Appendix J: Members of the Fraser River Technical Committee in 2010.....	63
Appendix K: Staff of the Pacific Salmon Commission in 2010.....	64

LIST OF TABLES

	<u>Page</u>
Table 1. Pre-season and in-season updates of management information in 2010	8
Table 2. Number of days when fishing occurred in Canadian commercial fisheries that targeted Fraser River sockeye salmon in 2010	13
Table 3. Number of days when fishing occurred in major U.S. net fisheries that targeted Fraser River sockeye salmon in the Fraser River Panel Area in 2010	14
Table 4. Panel-approved stock monitoring operations conducted in 2010	14
Table 5. Individual stocks included in the Fraser River sockeye stock groups used in 2010	15
Table 6. Pre-season, in-season and post-season DBE estimates	18
Table 7. End-of-season estimates of Fraser River sockeye passage at Mission in 2010	21
Table 8. Catch, escapement, RSA, abundance and exploitation rate estimates for Fraser River sockeye salmon by management group in 2010	22
Table 9. Catch, escapement, RSA, abundance and exploitation rate estimates for Fraser River sockeye salmon by stock group in 2010	23
Table 10. Canadian commercial catches of Fraser River sockeye salmon by gear type, license designation and statistical area during the 2010 fishing season	25
Table 11. U.S. commercial catches of Fraser River sockeye salmon by user group, gear type and statistical area during the 2010 fishing season	25
Table 12. Comparison of in-season potential spawning escapement (PSE) target (spawning escapement target plus MA) and in-season PSE estimate (Mission escapement minus catch above Mission) for adult Fraser River sockeye salmon in 2010	28
Table 13. Comparison of post-season spawning escapement targets and upriver escapement estimates for adult Fraser River sockeye salmon in 2010	29
Table 14. Summary calculation of the achievement of the Total Allowable Catch (TAC) of Fraser River sockeye salmon in 2010	30
Table 15. Achievement of domestic catch allocation objectives for Fraser sockeye salmon in the U.S. (Washington)	31
Table 16. Catch of non-Fraser sockeye and pink salmon and of other salmon species in commercial fisheries regulated by the Fraser River Panel in 2010	31
Table 17. Allocation status of Fraser River sockeye salmon for 2006-2010	32
Appendix B	
Table B1. Pre-season forecast of the 2010 Fraser River sockeye salmon return that incorporates recent productivity trends	36
Table B2. Fraser River sockeye salmon escapement plan for 2010 based on p50 pre-season forecast that incorporates recent productivity trends	37
Appendix H	
Table H1. Sampling details for Panel-approved test fisheries conducted in 2010	50
Appendix I	
Table I1. Catch by user group, spawning escapement, RSA and abundance of Fraser River sockeye salmon for cycle years 1998-2010	59
Table I2. Catch of Fraser River sockeye salmon in Canadian First Nations fisheries by area for cycle years 1998-2010	60
Table I3. Escapement of sockeye salmon to Fraser River spawning areas for cycle years 1998-2010	61
Table I4. Detailed calculation of the achievement of the Total Allowable Catch (TAC) of Fraser River sockeye salmon by management group in 2010	62

LIST OF FIGURES

Figure 1.	Fishery management areas in the Fraser River Panel Area and Canada's south coast waters	4
Figure 2.	The northern (Johnstone Strait) and southern (Juan de Fuca Strait) routes for sockeye and pink salmon migrating to the Fraser River.....	6
Figure 3.	Pre-season projections and post-season reconstructions of daily abundance of Fraser River sockeye salmon in 2010 (Area 20 date).....	16
Figure 4.	Pre-season expected annual Johnstone Strait diversion for Fraser River sockeye salmon, compared to observed short-term and annual rates	17
Figure 5.	Fraser River temperature and discharge measured near Hope, with mean temperature and discharge during the migration of each management group (excluding Pitt).....	19
Figure 6.	Estimates of sockeye salmon passage at Qualark based on Qualark hydroacoustic data compared to estimates based on unadjusted and adjusted Mission hydroacoustic data	20
Figure 7.	Total abundance and adult spawner abundance of Fraser River sockeye salmon between 1893-2010. Returns on the 2010 cycle are emphasized	24
Figure 8.	Total abundance, catch, escapement, RSA and exploitation rate for Fraser River sockeye salmon between 1986-2010, with returns on the 2010 cycle emphasized	24
Figure 9.	Sockeye salmon spawning grounds in the Fraser River watershed	26
Figure 10.	Adult spawning escapement of Fraser River sockeye salmon by year (1938-2010) for each management group, with escapements on the 2010 cycle emphasized.....	27
Figure 11.	Comparison of available harvest and catch-to-date of Fraser sockeye in 2010.....	29

Appendix H

Figure H1.	Deployment locations and sampling areas for the three DIDSON units in 2010	52
Figure H2.	Deployment locations and sampling areas for the mid-channel split-beam transducer in 2010	53
Figure H3.	Daily reconstructed abundance estimates for Fraser River sockeye salmon (by management group), and corresponding run-size estimates at different times during the season in 2010	56

I. EXECUTIVE SUMMARY

A. Pre-season Planning

1. Pre-season expectations for Fraser River sockeye salmon in 2010 included a total abundance of 11,439,000 fish. Pre-season planning was based on the p50-level (median) forecast abundances for all management groups: Early Stuart - 41,000 fish, Early Summer – 783,000 fish, Summer – 2,612,000 fish and Late run – 8,003,000 fish (Table 1). Birkenhead and Harrison sockeye were included in the Late-run management group.
2. Pre-season expectations of migration parameters included a 47% diversion rate of Fraser River sockeye through Johnstone Strait. Expected Area 20 50% migration dates were July 1 for Early Stuart, July 27 for Early Summer, August 3 for Summer and August 15 for Late-run sockeye (Table 1).
3. Pre-season spawning escapement goals as established by Canada's spawning escapement plan (Appendix B) were abundance based and at the p50 forecast level were 41,000 Early Stuart, 313,000 Early Summer, 1,045,000 Summer and 3,201,000 Late-run sockeye. In addition, Management Adjustments (MAs) of 16,000 Early Stuart, 194,000 Early Summer, 31,000 Summer and 1,120,000 Late-run sockeye were added to the spawning escapement targets to increase the likelihood of achieving the targets. The MAs for Early Stuart, Early Summer and Summer runs were based on relationships between river conditions (discharge and temperature) and historic differences between lower river and upriver escapement estimates. For Late-run sockeye, the Panel assumed a continuation of the early upstream migration behaviour and associated high mortality that has occurred since 1996, and assumed a median upstream migration date past Mission of September 6. The Late-run sockeye MA was based on average values for the Adams dominant cycle line (excluding 2006). In-season, if Late-run Mission timing (i.e., the 50% Mission date) was earlier than September 3, then an MA estimate based on Adams dominant and sub-dominant year data was to be used. The pre-season spawning escapement target and MA totalled 54% of the predicted Late-run return, resulting in an exploitation rate limit of 46%.
4. The projected Total Allowable Catch (TAC) of Fraser River sockeye salmon (Table 1) was 5,056,000 sockeye, of which the United States (U.S.) was allocated 16.5% minus a payback to Canada of 4,300 fish. Rules for calculating the TAC are set out in Annex IV, Chapter 4 of the Pacific Salmon Treaty and the February 11, 2010 Commission Guidance (Appendix C).
5. Domestic objectives within the U.S. included an allocation to Treaty Indian fishers of 67.7% of the U.S. share of the TAC minus the 4,300 fish payback, with the rest allocated to All Citizen fishers. In Canada, pre-season catch expectations for sockeye included 1,009,000 fish for First Nations FSC, 146,000 fish for recreational and 3,470,000 fish for commercial (including First Nations economic opportunity ("EO") and demonstration ("Demo")) fishers.
6. Pre-season modeling indicated it was unlikely the full TAC of Fraser sockeye could be harvested, due to mixed-stock constraints required to achieve the escapement targets for Early Summer and Late-run (e.g., Cultus) sockeye stocks.
7. The Panel adopted a management plan before the fishing season, including the "Principles and Constraints", "Guidelines to Address Late Run Concerns" and "2010 Regulations" (Appendices D, E and F). The normal regulatory framework was established whereby areas regulated by the Panel were closed unless opened by Panel order.

B. In-season Management Considerations

8. The total sockeye return was much larger than forecast, and the larger abundances were spread across all management groups. As a result there were substantial fishing opportunities for both countries.
9. All management groups returned later than expected. The Area 20 50% date for Early Stuart, Early Summer, Summer and Late sockeye runs were respectively 3, 13, 12 and 7 days later than expected (Figure 3).
10. The annual diversion rate for Fraser sockeye through Johnstone Strait (72%) was much higher than expected pre-season (Figure 4).

11. River temperatures were warmer than average for most of the season, but particularly between late July and mid August (Figure 5).
12. Due to an apparent discrepancy between Mission and Qualark estimates of fish passage and to observations of irregular fish behavior at Mission, estimates of Mission passage from the PSC's Mission hydroacoustic program were adjusted based on fish passage estimates from DFO's Qualark hydroacoustic program (Figure 6).

C. Run Size, Catch and Escapement

13. In-season estimates of run size totalled 34,546,000 Fraser sockeye (Table 1). The preliminary post-season accounted run size was 28,265,000 fish (Tables 8 and 9), more than double the brood year abundance in 2006 and almost three times the median forecast abundance. This is the largest run on the 2010 cycle since records began in 1893 and the largest on any cycle since 1913 (Figure 7). Divided into management groups, adult returns totalled 105,000 Early Stuart, 2,996,000 Early Summer, 5,753,000 Summer and 19,399,000 Late-run sockeye.
14. Catches of Fraser River sockeye salmon in all fisheries totalled 13,601,000 fish, including 11,569,000 fish caught by Canada, 1,960,000 fish by the U.S. and 72,000 fish by test fisheries (Table 8). Most of the catch was taken in Canadian commercial fisheries (includes EO and Demo), followed by U.S. commercial and Canadian First Nations FSC fisheries. The overall harvest rate was 48% of the run (Figure 8). The estimated catch of Fraser sockeye in Alaska was negligible (<50 fish).
15. DFO's near-final estimates of spawning escapements to streams in the Fraser River watershed totalled 13,131,000 adult sockeye (Tables 8 and 9). This was 2.8 times the brood year escapement and the largest escapement on record (Figure 7). Spawning escapements in 2010 were within the range observed in recent years for Early Stuart sockeye, the largest on record on any cycle for Early Summer sockeye, the second highest on record on the 2010 cycle for the Summer run and the largest on record on any cycle for the Late run (Figure 10). There were 5,832,000 effective female spawners in the Fraser watershed, representing an overall spawning success of only 80%.

D. Achievement of Objectives

16. 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.
17. In-season management decisions are based on targets for "Potential Spawning Escapement" (PSE), which are the sum of spawning escapement targets and Management Adjustments. In-season estimates of potential escapement (i.e., Mission passage minus catch above Mission) were less than the targets for Early Stuart (6% under) and Late-run groups (29% under), but exceeded the targets for Early Summer (20% over) and Summer groups (15% over) (Table 12).
18. Spawning ground estimates of abundance totalled 13,131,000 adults or 15% more than the post-season target. Spawner abundance was well below the target for Early Stuart sockeye (43% under), but exceeded the targets for Early Summer (27% over), Summer (30% over) and Late-run sockeye (10% over) (Table 13). For Early Stuart sockeye the spawning escapement target was the entire run and it was also subject to a large DBE (-39%), so the spawning escapement target was unattainable even in the absence of any fishery catch.
19. The exploitation rate for Late-run sockeye (including Cultus) was 51%.
20. Based on the TAC calculation method set out in Annex IV, Chapter 4 of the Pacific Salmon Treaty and the February 11, 2010 Commission Guidance, the Fraser sockeye TAC was 15,777,000 fish. The U.S. catch was 639,000 fish less than their share (Table 14) and the total catch in the U.S. and Canada was 2,659,000 fish less than the international TAC. In this calculation, the allowable catch is fixed on the date that Panel control of the last U.S. Panel Area was relinquished (October 2 in 2010), while catches are the post-season accounted totals.
21. In terms of domestic allocation objectives, Treaty Indian fishers in the U.S. caught 541,000 fish less than their share and All Citizen fishers caught 98,000 fish less (Table 15).
22. By-catches of non-Fraser sockeye and pink salmon in commercial fisheries regulated by the Fraser River Panel totalled 20,000 sockeye and 2,200 pink salmon in 2010 (Table 16).

Catches of other Fraser and non-Fraser salmon species included 8,700 chinook, 4,800 coho, 400 chum and zero steelhead.

E. Allocation Status

23. There are no paybacks due in future years for either Fraser River sockeye or pink salmon (Table 17).

II. FRASER RIVER PANEL

In 2010, 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 2010 “Commission Guidance to the Fraser River Panel” (Appendix C). The Fraser River Panel is responsible for in-season management of fisheries that target Fraser River sockeye salmon (and pink salmon in odd years) within the Panel Area (Figure 1), including commercial 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 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) historic 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.

Implicit to the management of all Panel-regulated fisheries is the principle that fisheries are to remain closed (Regulations, Appendix F) unless opened by specific order (In-season Orders, Appendix G). The management 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 K) of sockeye and pink salmon run size, migration timing and route, in-river migration abundance (i.e., Mission passage) 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.

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.

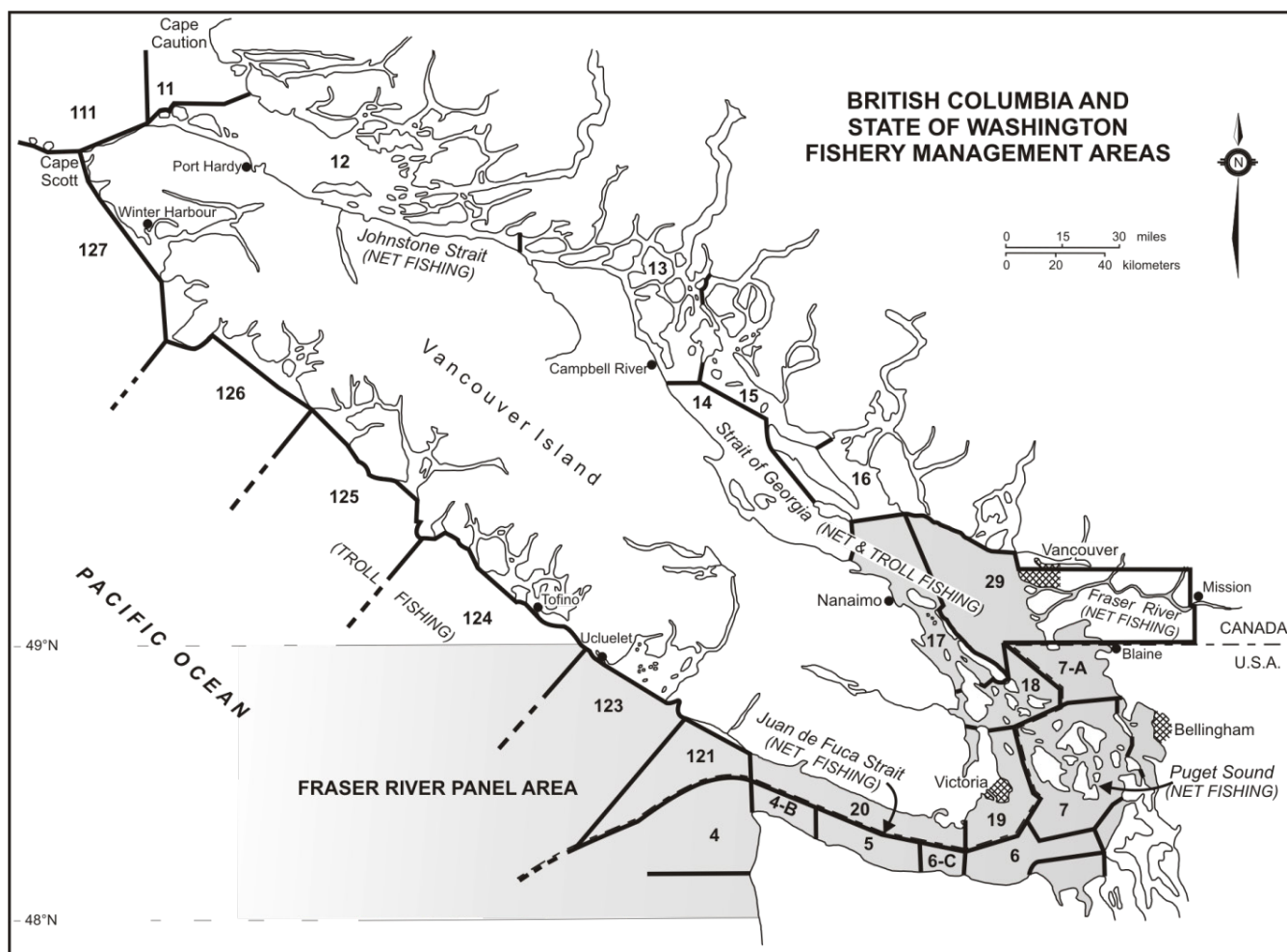


Figure 1. Fishery management areas in the Fraser River Panel Area and Canada's south coast waters.

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 are discussed in the following sections.

The pre-season management plan in 2010 focused on the achievement of spawning escapement targets for all Fraser sockeye management groups while pursuing the allowable harvest of Summer-run and Late Shuswap sockeye. The median (50% probability level) sockeye forecast of 11,439,000 fish assumed that the low productivity (i.e., adult returns per effective spawner) observed for Fraser sockeye in recent years would continue in 2010. The likely continuation of early upstream migration behaviour of Late-run sockeye and associated en route migration loss was addressed in the plan developed by the Panel. Canada provided an escapement plan for Fraser sockeye stocks in which exploitation rates varied with different levels of abundance. For Canadian fisheries, additional constraints were planned by DFO to protect Cultus Lake sockeye.

A. Pre-season Planning

Pre-season management plans for Panel Area fisheries were developed by the Panel using the Fishery Simulation Model². This model helps the Panel to evaluate the impacts of various fishery options on the achievement of management objectives. Model inputs include forecasts of abundance, migration timing, diversion rate and management adjustments (MAs), plus objectives for spawning escapement and catch allocation as described below.

Canada generated pre-season abundance forecasts for Fraser sockeye salmon under three different scenarios in 2010³. The first scenario, “Long-Term Average Productivity” produced forecasts using a similar methodology as for recent years. The second scenario, “Recent Productivity” incorporated new models that accounted for the low productivity observed in recent years. The third scenario, “Productivity Equivalent to the 2005 Brood Year” generated forecasts based on the assumption that productivity in 2010 would be similar to the very low productivity as represented by the number of effective female spawners in 2005 compared to adult returns in 2009. Canada recommended and the Panel adopted the “Recent Productivity” scenario for pre-season planning. Run-size forecasts were provided that corresponded to the 10%, 25%, 50%, 75% and 90% levels of probability, that actual returns would be less than the forecast abundances associated with the recent productivity scenario (Appendix B, Table B1). For example, there was a 1 out of 4 chance that actual returns would be less than the 25% probability level (p25) forecast of 7,028,000 sockeye, while at the p50 level (i.e., median) forecast there was an equal chance that the actual returns would be either above or below the forecast. The Panel adopted the median run-size forecasts for Early Stuart, Early Summer, Summer and Late-run sockeye for planning purposes, which totalled 11,439,000 fish. Birkenhead sockeye were included in the Late-run management group for the first time since 2003, because their migration timing has been later and more similar to other Late-run stocks in recent years.

At these abundance levels, spawning escapement targets totalled 4,600,000 Fraser sockeye (Table 1). The escapement targets were calculated using Total Allowable Mortality (i.e., TAM) rules from Canada’s spawning escapement plan (Appendix B, Table B2).

Management Adjustments were added to the escapement targets for all sockeye management groups to compensate for expected differences between in-season and spawning ground estimates of escapement (DBEs). For Early Stuart, Early Summer and Summer runs the MAs were based on regression models that relate historic DBE levels to environmental conditions (discharge and temperature) in the Fraser River near Hells Gate, with snowpack and weather-derived pre-season forecasts of such river conditions provided by DFO. Fraser River discharge was projected to be approximately 80% of the normal level for all management groups, primarily because of lower than average snowfall accumulations in the Fraser River watershed. The Late-run MA was based on average DBE values for the Adams dominant cycle line (i.e., 2010 cycle line, but excluding the 2006 data point). (Note: In-season, if Late-run Mission timing (i.e., the 50% Mission date) was earlier than September 3, then an MA model estimate based on Adams dominant and sub-dominant year data was to be used instead.) The Panel adopted pre-season pMA factors of 0.40 for Early Stuart, 0.62 for Early Summer, 0.03 for Summer sockeye and 0.35 for Late-run sockeye. The numerical MAs calculated from the spawning escapement targets and pMA factors are shown in Table 1. The combination of management adjustment and escapement target for Late-run sockeye resulted in a forecast exploitation rate limit of 46%.

Pre-season expectations of migration parameters included a 33% diversion rate of Fraser River sockeye through Johnstone Strait (Figure 2, forecast provided by DFO). The Panel adopted a revised value of 47% on June 9, which was used for pre-season planning. Expected Area 20 50% migration dates were July 1 for Early Stuart, July 27 for Early Summer, August 3 for Summer and August 15 for Late-run sockeye. These dates were based on DFO forecasts of Early Stuart and

² Cave, J.D. and W.J. Gazey. 1994. A pre-season simulation model for fisheries on Fraser River sockeye salmon (*O. nerka*). Can. J. Fish. Aquat. Sci. 51(7): 1535-1549.

³ Grant, S.C.H., Michielsens, C.G.J., Porszt, E.J., and Cass, A. 2010. Pre-season run size forecasts for Fraser River Sockeye salmon (*Oncorhynchus nerka*) in 2010. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/042. vi + 125 p.

Chilko timing, and timing correlations among the stocks. Area 20 dates are indices of marine migration timing and represent the date when 50% (half) of the total run would have entered Juan de Fuca Strait (Canadian Area 20) if the entire run had migrated via that route. Projected daily abundances generated from these dates, assuming a normally distributed migration curve, are shown in Figure 3.

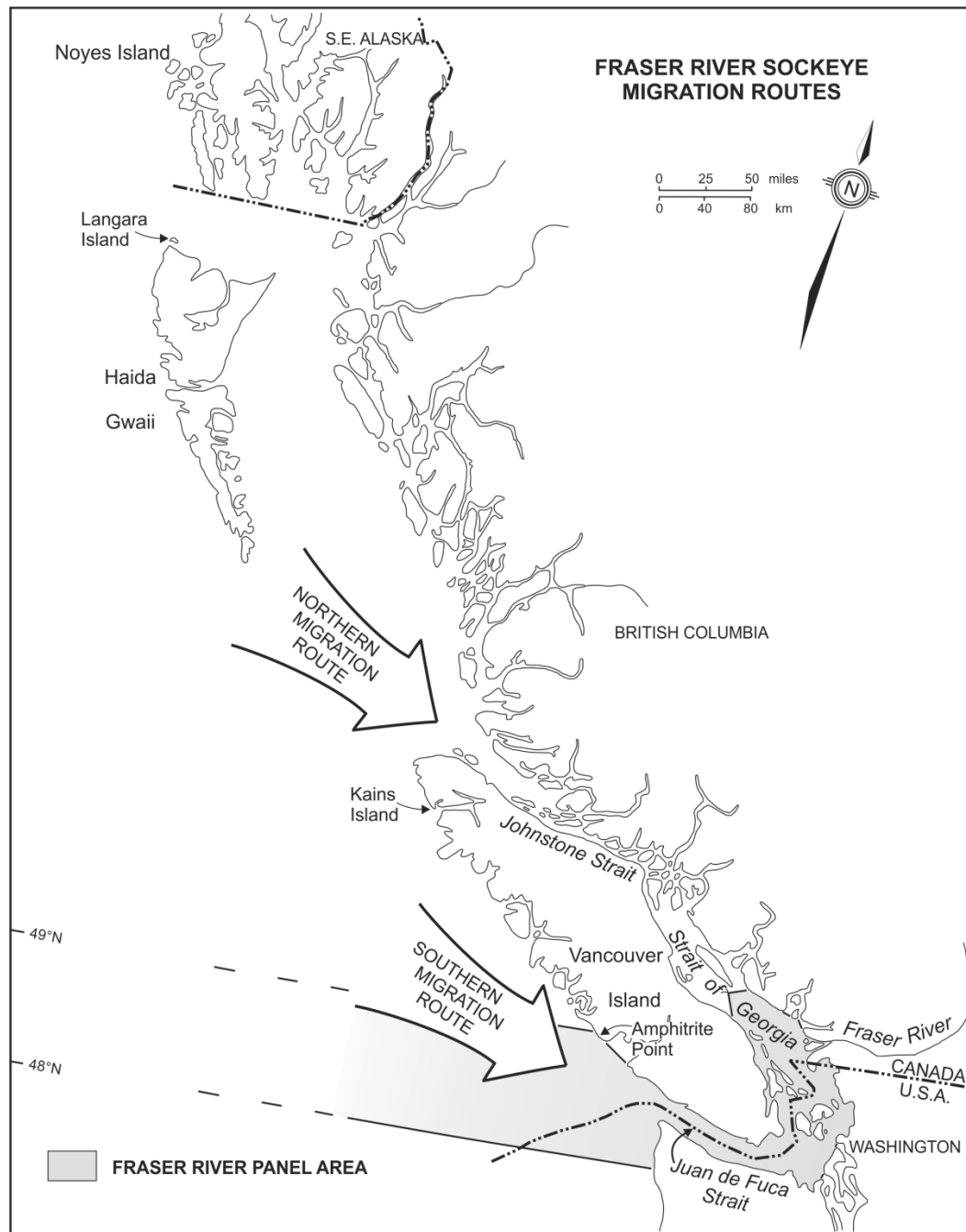


Figure 2. The northern (Johnstone Strait) and southern (Juan de Fuca Strait) routes for sockeye and pink salmon migrating to the Fraser River.

The Total Allowable Catch (TAC) and international harvest shares were to be calculated according to Annex IV, Chapter 4 of the Pacific Salmon Treaty¹ and the February 11, 2010 “Commission Guidance to the Fraser River Panel” (Appendix C). The pre-season projection of TAC based on the assumptions described above was 5,056,000 Fraser sockeye (Table 1). The

specified U.S. (Washington) share was 16.5% of the Fraser sockeye TAC, minus a payback of 4,300 sockeye to Canada.

In terms of domestic goals, Treaty Indian fishers were allocated 67.7% of the U.S. share of the TAC minus the payback of 4,300 sockeye, with the remainder allocated to All Citizen fishers. In Canada, pre-season catch expectations for sockeye included 260,000 fish for marine FSC (Food, Social and Ceremonial), 749,000 fish for in-river FSC, 31,000 fish for marine recreational and 115,000 fish for in-river recreational fishers. The remaining Canadian sockeye share (3,470,000 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 area-gear license 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.

During the pre-season planning process, the Parties identified stocks for which they had conservation and management concerns. Species and stocks identified by Canada included Cultus and Early Stuart sockeye stocks in the Fraser watershed, Sakinaw and Nimpkish sockeye, interior Fraser coho, spring run Fraser chinook, lower Strait of Georgia chinook including the Cowichan stock, west coast of Vancouver Island wild chinook and interior Fraser steelhead. The species and stocks identified by the United States included Hood Canal summer chum, Puget Sound chinook (including stocks from the south and north forks of the Nooksack River and south fork of the Stillaguamish River), mid Hood Canal Summer chinook and Dungeness chinook, Puget Sound steelhead and southern resident killer whales.

The Panel adopted a management plan in June, which included the “Management Plan Principles and Constraints”, “Guidelines to Address Late Run Concerns”, and “2010 Regulations” (Appendices D, E and F). In the pre-season plan, low impact fisheries in both U.S. and Canadian Panel waters were expected to start during the last week of July. If in-season assessments indicated the abundance or timing of returning Early Summer or Summer-run stocks were significantly different than forecast, then the date of commencement and duration of fisheries could be affected. In DFO’s Integrated Fisheries Management Plan for Salmon in Southern B.C.⁴ (IFMP), additional constraints were planned by DFO to protect Cultus Lake sockeye (i.e., the exploitation rate was to be limited to a maximum of 20-30%, depending on in-season abundance estimates for the Late-run aggregate. DFO modified this rule in late August to be a maximum of 30% or an exploitation rate that was consistent with recovery objectives based on in-season information on returns and potential numbers of effective spawners).

B. In-season Management

The Fraser River Panel convened 26 times between June 29 and October 6, to discuss run status and enact in-season orders (Appendix G) to regulate fisheries directed at Fraser River sockeye salmon harvest in Panel Areas. Fishing times and the dates that the Panel relinquished control of Canadian and U.S. Panel Areas are summarized in Tables 2 and 3, respectively.

The return of Fraser River sockeye salmon in 2010 was the largest return since 1913. The very strong return resulted in many fishing opportunities, large catches and record escapements for some Fraser sockeye stocks, and contrasted sharply with the extremely low return in 2009.

The data available to the Panel and management decisions made by the Panel during the 2010 fishing season are summarized below. Much of the corresponding in-season data are shown in Table 1. While not under Panel control, management of Canadian non-Panel fisheries directed at Fraser River sockeye salmon is based on the same in-season information and hierarchy of objectives, with priority given to First Nations harvest within Canada’s allocation. Fishing effort in Canadian First Nations fisheries is not shown in Table 2.

⁴ 2010/2011 Southern B.C. Salmon Integrated Fishery Management Plan. Fisheries and Oceans Canada.

Table 1. Pre-season and in-season updates of run size, spawning escapement target and other TAC-related values for Fraser River sockeye salmon in 2010. 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.

			TAC						Available				50% Migration Date	
			Spawning Escapement		Management		Test	Aboriginal Fishery	Total Allowable	Harvest (incl. TF + AFE)	Catch to date	Mission Escape. to date		
Date	Management Group	Total Abundance	Target	pMA	Adjust.	Fishing	Exemption	Catch				Area 20	Mission	
June 9	Pre-season	Early Stuart	41,000	41,000	0.40	16,400	500	4,100	0	0	0	0	1-Jul	7-Jul
		Early Summer	783,300	313,320	0.62	194,300	6,900	41,600	227,180	268,780	0	0	27-Jul	2-Aug
		Summer	2,612,000	1,044,800	0.03	31,300	13,100	228,500	1,294,300	1,522,800	0	0	3-Aug	9-Aug
		Late	8,003,000	3,201,200	0.35	1,120,400	21,500	125,800	3,534,100	3,659,900	0	0	15-Aug	6-Sep
		Sockeye	11,439,300	4,600,320	1,362,400	42,000	400,000	5,055,580	5,451,480	0	0			
June 29	In-season	Early Stuart	41,000	41,000	0.40	16,400	500	4,100	0	0	170	1,900	1-Jul	7-Jul
		Early Summer	783,300	313,320	0.62	194,300	6,900	41,600	227,180	275,680	0	0	27-Jul	2-Aug
		Summer	2,612,000	1,044,800	0.03	31,300	13,100	228,500	1,294,300	1,535,900	0	0	3-Aug	9-Aug
		Late	8,003,000	3,201,200	0.35	1,120,400	21,500	125,800	3,534,100	3,681,400	0	0	15-Aug	6-Sep
		Sockeye	11,439,300	4,600,320	1,362,400	42,000	400,000	5,055,580	5,492,980	170	1,900			
July 6	In-season	Early Stuart	41,000	41,000	0.40	16,400	500	4,100	0	0	1,000	9,400	1-Jul	7-Jul
		Early Summer	783,300	313,320	0.62	194,300	6,900	41,600	227,180	275,680	40	0	27-Jul	2-Aug
		Summer	2,612,000	1,044,800	0.03	31,300	13,100	228,500	1,294,300	1,535,900	0	0	3-Aug	9-Aug
		Late	8,003,000	3,201,200	0.35	1,120,400	21,500	125,800	3,534,100	3,681,400	10	0	15-Aug	6-Sep
		Sockeye	11,439,300	4,600,320	1,362,400	42,000	400,000	5,055,580	5,492,980	1,050	9,400			
July 9	In-season	Early Stuart	110,000	110,000	0.40	44,000	2,000	4,100	0	0	1,600	34,010	6-Jul	12-Jul
		Early Summer	783,300	313,320	0.62	194,300	6,900	41,600	227,180	275,680	100	1,990	27-Jul	2-Aug
		Summer	2,612,000	1,044,800	0.03	31,300	13,100	228,500	1,294,300	1,535,900	0	0	3-Aug	9-Aug
		Late	8,003,000	3,201,200	0.35	1,120,400	21,500	125,800	3,534,100	3,681,400	50	0	15-Aug	6-Sep
		Sockeye	11,508,300	4,669,320	1,390,000	43,500	400,000	5,055,580	5,492,980	1,750	36,000			
July 13	In-season	Early Stuart	110,000	110,000	0.17	18,700	2,000	4,100	0	0	2,050	67,640	5-Jul	11-Jul
		Early Summer	783,300	313,320	0.62	194,300	6,900	41,600	227,180	275,680	410	5,920	27-Jul	2-Aug
		Summer	2,612,000	1,044,800	0.03	31,300	13,100	228,500	1,294,300	1,535,900	20	20	3-Aug	9-Aug
		Late	8,003,000	3,201,200	0.35	1,120,400	21,500	125,800	3,534,100	3,681,400	260	830	15-Aug	6-Sep
		Sockeye	11,508,300	4,669,320	1,364,700	43,500	400,000	5,055,580	5,492,980	2,740	74,410			
July 16	In-season	Early Stuart	90,000	90,000	0.12	10,800	2,000	4,100	0	0	2,300	75,730	4-Jul	10-Jul
		Early Summer	783,300	313,320	0.62	194,300	6,900	41,600	227,180	275,680	590	12,320	27-Jul	2-Aug
		Summer	2,612,000	1,044,800	0.03	31,300	13,100	228,500	1,294,300	1,535,900	70	2,240	3-Aug	9-Aug
		Late	8,003,000	3,201,200	0.35	1,120,400	21,500	125,800	3,534,100	3,681,400	300	3,950	15-Aug	6-Sep
		Sockeye	11,488,300	4,649,320	1,356,800	43,500	400,000	5,055,580	5,492,980	3,260	94,240			
July 20	In-season	Early Stuart	90,000	90,000	0.12	10,800	2,000	4,100	0	0	2,620	84,870	4-Jul	10-Jul
		Early Summer	783,300	313,320	0.62	194,300	6,900	41,600	227,180	275,680	1,270	18,750	27-Jul	2-Aug
		Summer	2,612,000	1,044,800	0.03	31,300	13,100	228,500	1,294,300	1,535,900	310	4,510	3-Aug	9-Aug
		Late	8,003,000	3,201,200	0.35	1,120,400	21,500	125,800	3,534,100	3,681,400	840	7,460	15-Aug	6-Sep
		Sockeye	11,488,300	4,649,320	1,356,800	43,500	400,000	5,055,580	5,492,980	5,040	115,590			
July 23	In-season	Early Stuart	90,000	90,000	0.12	10,800	2,000	4,100	0	0	2,910	82,020	4-Jul	10-Jul
		Early Summer	783,300	313,320	0.62	194,300	6,900	41,600	227,180	275,680	4,280	39,430	27-Jul	2-Aug
		Summer	2,612,000	1,044,800	0.03	31,300	13,100	228,500	1,294,300	1,535,900	1,420	6,340	3-Aug	9-Aug
		Late	8,003,000	3,201,200	0.35	1,120,400	21,500	125,800	3,534,100	3,681,400	2,290	32,350	15-Aug	6-Sep
		Sockeye	11,488,300	4,649,320	1,356,800	43,500	400,000	5,055,580	5,492,980	10,900	160,140			
July 27	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,800	4,100	0	0	2,820	100,170	5-Jul	11-Jul
		Early Summer	783,300	313,320	0.62	194,300	15,000	41,600	219,080	275,680	7,630	118,850	27-Jul	2-Aug
		Summer	2,612,000	1,044,800	0.03	31,300	13,100	228,500	1,294,300	1,535,900	2,620	32,210	3-Aug	9-Aug
		Late	8,003,000	3,201,200	0.35	1,120,400	21,500	125,800	3,534,100	3,681,400	3,810	60,230	15-Aug	6-Sep
		Sockeye	11,503,300	4,664,320	1,354,400	52,400	400,000	5,047,480	5,492,980	16,880	311,460			
July 30	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,800	4,100	0	0	3,380	100,270	5-Jul	11-Jul
		Early Summer	950,000	380,000	0.62	235,600	15,000	41,600	277,800	334,400	18,130	240,650	28-Jul	3-Aug
		Summer	2,612,000	1,044,800	0.03	31,300	13,100	228,500	1,294,300	1,535,900	8,290	104,750	3-Aug	9-Aug
		Late	8,208,000	3,283,200	0.35	1,149,100	21,500	125,800	3,628,400	3,775,700	9,030	122,350	15-Aug	6-Sep
		Sockeye	11,875,000	4,813,000	1,424,400	52,400	400,000	5,200,500	5,646,000	38,830	568,020			

Table 1, continued on next page

Table 1, continued.

			TAC						Available		Mission		50% Migration	
			Spawning Escapement	Manage- ment	Test	Aboriginal Fishery	Total Allowable	Harvest (incl. TF + AFE)	Catch to date	Escape. to date				
Date	Management Group	Total Abundance	Target	pMA	Adjust.	Fishing	Exemption	Catch					Area 20	Mission Date
August 3	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,800	4,100	0	0	3,410	100,730	5-Jul	11-Jul
		Early Summer	950,000	380,000	0.62	235,600	15,000	41,600	277,800	334,400	35,710	412,880	28-Jul	3-Aug
		Summer	2,612,000	1,044,800	0.03	31,300	13,100	228,500	1,294,300	1,535,900	21,970	212,310	3-Aug	9-Aug
		Late	8,208,000	3,283,200	0.35	1,149,100	21,500	125,800	3,628,400	3,775,700	23,200	251,460	15-Aug	6-Sep
		Sockeye	11,875,000	4,813,000	1,424,400	52,400	400,000	5,200,500	5,646,000	84,290	977,380			
August 6	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,400	4,100	0	0	4,190	101,280	5-Jul	11-Jul
		Early Summer	1,600,000	640,000	0.84	537,600	22,000	41,600	358,800	422,400	110,270	641,190	2-Aug	8-Aug
		Summer	2,612,000	1,044,800	0.03	31,300	20,000	228,500	1,287,400	1,535,900	80,010	379,900	3-Aug	9-Aug
		Late	8,208,000	3,283,200	0.35	1,149,100	25,000	125,800	3,624,900	3,775,700	69,860	331,700	15-Aug	6-Sep
		Sockeye	12,525,000	5,073,000	1,726,400	69,400	400,000	5,271,100	5,734,000	264,330	1,454,070			
August 9	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,400	4,100	0	0	4,490	101,270	5-Jul	11-Jul
		Early Summer	1,600,000	640,000	0.84	537,600	22,000	41,600	358,800	422,400	269,700	762,390	2-Aug	8-Aug
		Summer	2,612,000	1,044,800	0.03	31,300	20,000	228,500	1,287,400	1,535,900	235,260	515,080	3-Aug	9-Aug
		Late	8,208,000	3,283,200	0.35	1,149,100	25,000	125,800	3,624,900	3,775,700	238,670	489,300	15-Aug	6-Sep
		Sockeye	12,525,000	5,073,000	1,726,400	69,400	400,000	5,271,100	5,734,000	748,120	1,868,040			
August 11	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,400	4,100	0	0	4,660	101,270	5-Jul	11-Jul
		Early Summer	1,600,000	640,000	0.84	537,600	22,000	41,600	358,800	422,400	383,120	966,970	2-Aug	8-Aug
		Summer	2,612,000	1,044,800	0.03	31,300	20,000	228,500	1,287,400	1,535,900	329,910	633,480	3-Aug	9-Aug
		Late	8,208,000	3,283,200	0.35	1,149,100	25,000	125,800	3,624,900	3,775,700	317,320	537,580	15-Aug	6-Sep
		Sockeye	12,525,000	5,073,000	1,726,400	69,400	400,000	5,271,100	5,734,000	1,035,010	2,239,300			
August 13	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,400	4,100	0	0	4,820	101,260	5-Jul	11-Jul
		Early Summer	2,000,000	800,000	1.00	800,000	22,000	41,600	336,400	400,000	433,440	1,129,290	3-Aug	9-Aug
		Summer	2,600,000	1,040,000	0.24	249,600	20,000	228,500	1,061,900	1,310,400	385,000	760,050	10-Aug	16-Aug
		Late	8,508,000	3,403,200	0.35	1,191,100	25,000	125,800	3,762,900	3,913,700	345,840	596,900	15-Aug	6-Sep
		Sockeye	13,213,000	5,348,200	2,249,100	69,400	400,000	5,161,200	5,624,100	1,169,100	2,587,500			
August 15	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,400	4,100	0	0	4,840	101,260	5-Jul	11-Jul
		Early Summer	2,400,000	960,000	0.80	768,000	25,000	41,600	605,400	672,000	434,540	1,206,400	4-Aug	10-Aug
		Summer	3,000,000	1,200,000	0.24	288,000	27,000	228,500	1,256,500	1,512,000	442,390	967,400	10-Aug	16-Aug
		Late	8,508,000	3,403,200	0.35	1,191,100	30,000	125,800	3,757,900	3,913,700	380,210	715,590	15-Aug	6-Sep
		Sockeye	14,013,000	5,668,200	2,255,500	84,400	400,000	5,619,800	6,097,700	1,261,980	2,990,650			
August 17	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,400	4,100	0	0	5,060	101,340	5-Jul	11-Jul
		Early Summer	2,600,000	1,040,000	0.71	738,400	25,000	41,600	755,000	821,600	519,450	1,339,520	6-Aug	12-Aug
		Summer	3,300,000	1,320,000	0.22	290,400	27,000	228,500	1,434,100	1,689,600	589,130	1,086,810	11-Aug	17-Aug
		Late	8,508,000	3,403,200	0.35	1,191,100	30,000	125,800	3,757,900	3,913,700	555,470	886,290	15-Aug	6-Sep
		Sockeye	14,513,000	5,868,200	2,228,300	84,400	400,000	5,947,000	6,424,900	1,669,110	3,413,960			
August 20	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,400	4,100	0	0	5,360	100,870	5-Jul	11-Jul
		Early Summer	2,900,000	1,160,000	0.39	452,400	25,000	41,600	1,221,000	1,287,600	690,070	1,897,930	7-Aug	13-Aug
		Summer	4,000,000	1,600,000	0.22	352,000	27,000	228,500	1,792,500	2,048,000	912,840	1,769,290	11-Aug	17-Aug
		Late	12,141,000	4,856,400	0.35	1,699,700	30,000	125,800	5,429,100	5,584,900	1,134,560	1,371,170	17-Aug	8-Sep
		Sockeye	19,146,000	7,721,400	2,512,500	84,400	400,000	8,442,600	8,920,500	2,742,830	5,139,260			
August 24	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,400	4,100	0	0	5,520	100,910	5-Jul	11-Jul
		Early Summer	3,200,000	1,280,000	0.38	486,400	25,000	41,600	1,367,000	1,433,600	859,150	2,234,480	7-Aug	13-Aug
		Summer	4,500,000	1,800,000	0.15	270,000	25,000	228,500	2,176,500	2,430,000	1,282,280	2,285,620	13-Aug	19-Aug
		Late	17,241,000	6,896,400	0.35	2,413,700	27,000	125,800	7,778,100	7,930,900	1,939,580	1,691,270	19-Aug	10-Sep
		Sockeye	25,046,000	10,081,400	3,178,500	79,400	400,000	11,321,600	11,794,500	4,086,530	6,312,280			
August 27	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,400	4,100	0	0	5,960	100,930	5-Jul	11-Jul
		Early Summer	3,700,000	1,480,000	0.36	532,800	25,000	41,600	1,620,600	1,687,200	1,067,310	2,473,440	9-Aug	15-Aug
		Summer	4,800,000	1,920,000	0.15	288,000	25,000	228,500	2,338,500	2,592,000	1,572,610	2,471,060	15-Aug	21-Aug
		Late	21,441,000	8,576,000	0.35	3,001,600	27,000	125,800	9,710,600	9,863,400	3,077,220	1,838,780	20-Aug	10-Sep
		Sockeye	30,046,000	12,081,000	3,830,800	79,400	400,000	13,669,700	14,142,600	5,723,100	6,884,210			
August 31	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,400	4,100	0	0	5,780	100,900	5-Jul	11-Jul
		Early Summer	3,700,000	1,480,000	0.36	532,800	25,000	41,600	1,620,600	1,687,200	1,180,180	2,587,080	9-Aug	15-Aug
		Summer	4,800,000	1,920,000	0.15	288,000	25,000	228,500	2,338,500	2,592,000	2,035,960	2,880,760	15-Aug	21-Aug
		Late	25,441,000	10,176,400	0.35	3,561,700	27,000	125,800	11,550,100	11,702,900	4,626,470	1,978,800	22-Aug	12-Sep
		Sockeve	34,046,000	13,681,400	4,390,900	79,400	400,000	15,509,200	15,982,100	7,848,390	7,547,540			

Table 1, continued on next page

Table 1, continued.

			TAC						Available			50% Migration Date		
			Spawning Escapement		Manage- ment		Aboriginal Test	Fishery	Total Allowable	Harvest (incl. TF	Catch			Mission Escape.
Date	Management Group	Total Abundance	Target	pMA	Adjust.	Fishing	Exemption	Catch	+ AFE)	to date	to date	Area 20	Mission	
Sep. 3	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,400	4,100	0	0	5,910	101,020	5-Jul	11-Jul
		Early Summer	3,700,000	1,480,000	0.36	532,800	25,000	41,600	1,620,600	1,687,200	1,208,370	2,653,460	9-Aug	15-Aug
		Summer	4,800,000	1,920,000	0.15	288,000	25,000	228,500	2,338,500	2,592,000	2,081,510	3,015,370	15-Aug	21-Aug
		Late	25,441,000	10,176,400	0.35	3,561,700	27,000	125,800	11,550,100	11,702,900	6,300,470	2,227,010	22-Aug	12-Sep
		Sockeye	34,046,000	13,681,400	4,390,900	79,400	400,000	15,509,200	15,982,100	9,596,260	7,996,860			
Sep. 7	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,400	4,100	0	0	5,920	100,920	5-Jul	11-Jul
		Early Summer	3,800,000	1,520,000	0.36	547,200	25,000	41,600	1,666,200	1,732,800	1,245,830	2,689,120	9-Aug	15-Aug
		Summer	5,200,000	2,080,000	0.15	312,000	25,000	228,500	2,554,500	2,808,000	2,288,250	3,119,650	15-Aug	21-Aug
		Late	25,441,000	10,176,400	0.35	3,561,700	27,000	125,800	11,550,100	11,702,900	7,370,780	3,674,280	22-Aug	12-Sep
		Sockeye	34,546,000	13,881,400	4,429,300	79,400	400,000	15,770,800	16,243,700	10,910,780	9,583,970			
Sep. 10	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,400	4,100	0	0	6,070	101,140	5-Jul	11-Jul
		Early Summer	3,800,000	1,520,000	0.36	547,200	25,000	41,600	1,666,200	1,732,800	1,223,780	2,712,400	9-Aug	15-Aug
		Summer	5,200,000	2,080,000	0.15	312,000	25,000	228,500	2,554,500	2,808,000	2,285,980	3,158,050	15-Aug	21-Aug
		Late	25,441,000	10,176,400	0.35	3,561,700	27,000	125,800	11,550,100	11,702,900	8,295,270	3,965,970	22-Aug	12-Sep
		Sockeye	34,546,000	13,881,400	4,429,300	79,400	400,000	15,770,800	16,243,700	11,811,100	9,937,560			
Sep. 14	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,400	4,100	0	0	6,090	101,240	5-Jul	11-Jul
		Early Summer	3,800,000	1,520,000	0.36	547,200	25,000	41,600	1,666,200	1,732,800	1,236,620	2,703,340	9-Aug	15-Aug
		Summer	5,200,000	2,080,000	0.15	312,000	25,000	228,500	2,554,500	2,808,000	2,300,850	3,141,550	15-Aug	21-Aug
		Late	25,441,000	10,176,400	0.35	3,561,700	27,000	125,800	11,550,100	11,702,900	9,248,510	5,845,780	22-Aug	12-Sep
		Sockeye	34,546,000	13,881,400	4,429,300	79,400	400,000	15,770,800	16,243,700	12,792,070	11,791,910			
Sep. 17	In-season	Early Stuart	105,000	105,000	0.08	8,400	2,400	4,100	0	0	6,060	100,850	5-Jul	11-Jul
		Early Summer	3,800,000	1,520,000	0.36	547,200	25,000	41,600	1,666,200	1,732,800	1,234,190	2,701,200	9-Aug	15-Aug
		Summer	5,200,000	2,080,000	0.15	312,000	25,000	228,500	2,554,500	2,808,000	2,322,620	3,136,530	15-Aug	21-Aug
		Late	25,441,000	10,176,400	0.35	3,561,700	27,000	125,800	11,550,100	11,702,900	9,546,250	6,887,120	22-Aug	12-Sep
		Sockeye	34,546,000	13,881,400	4,429,300	79,400	400,000	15,770,800	16,243,700	13,109,120	12,825,700			
October 2	TAC Date *	Early Stuart	105,000	105,000	0.08	8,400	2,400	4,100	0	0	6,080	100,850	5-Jul	11-Jul
		Early Summer	3,800,000	1,520,000	0.36	547,200	25,000	41,600	1,666,200	1,732,800	1,240,520	2,702,130	9-Aug	15-Aug
		Summer	5,200,000	2,080,000	0.15	312,000	25,000	228,500	2,554,500	2,808,000	2,347,520	3,148,450	15-Aug	21-Aug
		Late	25,441,000	10,176,400	0.35	3,561,700	27,000	125,800	11,550,100	11,702,900	10,052,340	10,384,700	22-Aug	12-Sep
		Sockeye	34,546,000	13,881,400	4,429,300	79,400	400,000	15,770,800	16,243,700	13,646,460	16,336,130			

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

June 27 – July 3: The first in-season Panel meeting took place on June 29. Low catches of Early Stuart sockeye in test fisheries suggested that they were tracking below forecast or their marine timing was later than expected. Fraser River discharge as measured near Hope (5,900 m³/s) was slightly lower than average, while the water temperature (14.9°C) was close to average. Canada provided a pre-season forecast of the Early Stuart Area 20 date (July 2).

July 4 - 10: Marine test fishery catches indicated a steady migration of sockeye through Juan de Fuca Strait. DNA analyses indicated that Early Stuart sockeye dominated samples from Area 20, with low proportions of Early Summer and Harrison sockeye also present. Approximately 36,000 sockeye were estimated to have migrated past Mission to-date. The discharge of the Fraser River (4,500 m³/s) was approximately 25% lower than average, while the water temperature of 15.8°C was forecast to increase rapidly. The Panel approved a run-size estimate of 110,000 Early Stuart sockeye (almost triple the 50% probability level forecast of 41,000 fish) and a 50% marine timing date through Area 20 (hereafter referred to as “marine timing”) of July 6, which was five days later than pre-season expectations.

July 11 - 17: Test fishing assessments indicated that there was a lull in the migration of Fraser sockeye through the marine approaches, which often occurs during the transition between the Early Stuart and Early Summer sockeye migrations. The Panel deferred starting the purse seine test fisheries until marine abundances of Fraser River sockeye increased. The diversion rate of Fraser sockeye through Johnstone Strait was estimated to be 17%. DNA analyses indicated moderate proportions of Early Stuart, Early Summer and Harrison sockeye in marine samples,

with a low contribution of Summer-run sockeye. The discharge level in the Fraser River (4,500 m³/s) was 19% lower than average, while the water temperature of 16.5°C was 0.5°C higher than average. The Panel adopted an Early Stuart pMA estimate of 0.12, which was much lower than the pre-season estimate of 0.40. The Panel approved a lower run-size estimate of 90,000 Early Stuart sockeye and a marine timing of July 4.

July 18 - 24: Sockeye catches in the Area 20 gillnet and Area 7 reefnet test fisheries indicated increasing numbers of migrating Fraser sockeye. The diversion rate of Fraser sockeye through Johnstone Strait continued to be low (about 6%). Run-size assessments for Early Stuart sockeye were based on the estimated number that had migrated past the Mission hydroacoustic site and the Panel deferred an update until the following week. Assessments suggested that Harrison sockeye were returning in higher than forecast abundance, while Early Miscellaneous Early Summer-run stocks were tracking below forecast or their timing was later than expected. Migration conditions for sockeye in the Fraser River continued to be satisfactory. Fraser River discharge (3,500 m³/s) was 30% lower than average, while the water temperature (17.3°C) was 0.5°C higher than average. In the pre-season fishing plan, the first Panel Area fisheries were scheduled to start the following week, depending on stock proportions and the estimated abundances of Early Summer and Summer-run sockeye that had migrated through Area 20 and past Mission. Stock proportions and abundance levels, however, were inconsistent with starting Panel Area fisheries.

July 25 - 31: Sockeye catches in the test fisheries were variable but generally good. The escapement of sockeye past Mission had increased in recent days, while the diversion rate of Fraser sockeye through Johnstone Strait had increased to 30%. The abundance of Early Summer-run sockeye was tracking above expectations and their marine timing was projected to be later than expected. Summer-run sockeye assessments suggested that their abundance was lower than expected if their marine timing was close to the pre-season forecast. The Panel adopted an increased Early Stuart run size of 105,000 fish with marine timing of July 5. The Panel approved provisional run-size estimates for management purposes of 950,000 Early Summer and 400,000 Harrison sockeye. Fraser River discharge (3,500 m³/s) was 23% lower than average, while the water temperature (18.6°C) was 1.2°C higher than average. The Panel adopted a reduced Early Stuart pMA estimate of 0.08 and approved a low impact drift gillnet fishery in U.S. Panel Areas 4B, 5, 6C.

August 1 - 7: Test fishing catches this week indicated the migration of Fraser sockeye was increasing through both approach routes. The diversion rate of Fraser sockeye through Johnstone Strait was 50% early in the week and then declined to slightly lower than 30% later in the week. DNA analyses indicated that the stock composition of Fraser sockeye in the marine approach areas was about 30% Early Summer, 32% Summer and 38% Late-run sockeye. As expected from the pre-season forecast and marine timing assumptions, Late Shuswap sockeye were the most abundant Late-run stock in marine areas. The Scotch/Seymour component of the Early Summer run showed continued strength in marine areas. Summer-run sockeye continued to track below their forecast run size unless their marine timing was substantially later than expected. The Panel approved an increased Early Summer run size of 1,600,000 fish, with marine timing of August 2. Fraser River discharge (3,200 m³/s) was 22% lower than average, while the water temperature (19.0°C) was 1.4°C higher than average. The Panel was advised that water temperatures above 19.0°C can adversely affect the upstream migration of Fraser sockeye. The Panel approved an increased Early Summer pMA of 0.84, and a suite of fisheries in Canadian and U.S. Panel Areas to harvest the available TAC.

August 8-14: Test fishing and commercial catch data indicated a variable but increasing migration of Fraser sockeye through both Juan de Fuca and Johnstone Straits. Assessments indicated the marine timing of Early Summer and Summer-run sockeye were considerably later than pre-season expectations. DNA analyses indicated that the stock composition of Fraser sockeye in Areas 12 and 20 was averaging about 15% Early Summer, 30% Summer and 55% Late-run sockeye. The diversion rate of Fraser sockeye through Johnstone Strait was approximately 45%. Sockeye migration past Mission and Hells Gate was strong over the past several days. DFO reported that large numbers of healthy Early Summer sockeye were arriving at the Scotch Creek enumeration fence. Discharge levels in the Fraser River (3,000 m³/s) were 19% lower than average, while the water temperature (18.3°C) was 0.5°C higher than average. The

Panel approved the following: increased Early Summer run size of 2,000,000 fish with an Area 20 marine timing of August 3 and increased pMA of 1.0; Summer-run run size of 2,600,000 fish with a marine timing of August 10 and increased pMA of 0.24; and increased Harrison run size from 400,000 fish to 700,000 fish with marine timing of August 4. Run-size and pMA estimates for Early Summer-run sockeye constrained the available TAC, so the Panel did not approve additional fisheries except for an ongoing low impact Area H troll fishery in Canada.

August 15 - 21: Purse seine test fishery catches of sockeye were very strong in Juan de Fuca Strait and especially in Johnstone Strait. The large catches and other assessment data resulted in higher run-size estimates for several Fraser River sockeye runs and increased the TAC. DNA analyses of samples from Areas 12 and 20 averaged 8% Early Summer, 16% Summer and 76% Late-run sockeye. Assessments indicated that Fraser sockeye runs were later than expected pre-season, and that the diversion rate of Fraser sockeye through Johnstone Strait had increased to about 75%. Sockeye migration past Mission and Hells Gate continued to be strong. Beginning on August 20, Mission-based estimates of sockeye migration were adjusted using estimates from the Qualark hydroacoustic program (refer to “Mission Escapement” in the “Management Actions” section for further details). These adjustments were applied retroactively to August 1 and they continued through the remainder of the season. Fraser River discharge (2,500 m³/s) was 25% lower than average, while the water temperature (19.0°C) was 1.5°C higher than average. There were many updates of run size, marine timing and management adjustments for Fraser sockeye: Early Summer – run size increased to 2,400,000 fish (August 4 marine timing), then 2,600,000 fish (August 6 marine timing) and finally 2,900,000 fish (August 7 marine timing), pMA decreased to 0.80, then 0.71 and further to 0.39; Summer – run size increased to 3,000,000 fish (August 10 marine timing), then 3,300,000 fish (August 11 marine timing) and finally 4,000,000 fish (August 11 marine timing), pMA decreased 0.22; Harrison – increased to 900,000 fish (August 6 marine timing); and Late Shuswap/Weaver sockeye increased to 11,000,000 fish (August 17 marine timing). The Panel approved several fisheries in both the U.S. and Canada to harvest the available TAC.

August 22 - 28: Purse seine test fishery catches of sockeye were extremely strong in Johnstone Strait (e.g., 97,000 fish in Area 12 on August 26), while catches in the Area 20 purse seine test fishery were lower but steady. Many fishers reported that sockeye abundance was the highest they had ever experienced. The diversion rate of Fraser sockeye through Johnstone Strait increased to 94%. The large catches of Fraser sockeye as well as their apparent late timing resulted in substantially increased run-size estimates. The Panel reported in their weekly news release that the 2010 return of Fraser sockeye was the largest since 1913. DNA analyses indicated that stock composition in Areas 12 and 20 was averaging about 5% Summer and 95% Late-run sockeye. Sockeye migration past Mission and Hells Gate continued to be strong and migration conditions for sockeye in the Fraser River were satisfactory. DFO reported that sockeye arriving at spawning grounds in the Fraser watershed were generally in good condition with little en route or pre-spawning mortality observed, which contributed to reduced management adjustments for some Fraser sockeye runs. The Panel adopted several updates as follows: Early Summer – run size increased to 3,200,000 fish (August 7 marine timing) and then 3,700,000 fish (August 9 marine timing), pMA decreased to 0.38 and then 0.36; Summer – increased to 4,500,000 fish (August 13 marine timing) and then 4,800,000 fish (August 15 marine timing), pMA decreased to 0.15; Harrison – increased to 1,000,000 fish (August 8 marine timing) and then 1,200,000 fish (August 11 marine timing); and Late Shuswap/Weaver sockeye increased to 16,000,000 fish (August 19 marine timing) and then 20,000,000 fish (August 20 marine timing). The Panel approved several fisheries in both the U.S. and Canada to harvest the available TAC.

August 29 – September 4: The marine migration of Fraser sockeye through Johnstone and Juan de Fuca Straits declined this week, while the Johnstone Strait diversion rate remained high (95%). Assessments indicated that a large number of Late-run sockeye were delaying in the lower Strait of Georgia. The sockeye migration past Mission had declined and migration conditions for sockeye in the Fraser River were satisfactory. The Panel approved an increased run-size estimate of 24,000,000 Late Shuswap/Weaver sockeye with marine timing of August 22. The Panel approved fisheries in U.S. and Canadian areas to harvest the available TAC.

September 5 – 11: The migration of Fraser sockeye through marine areas declined rapidly this week. The purse seine test fisheries in both Johnstone and Juan de Fuca Straits were terminated for the season. Ongoing marine assessments, including the troll test fishery in the Strait of Georgia, continued to suggest that a large number of Late-run sockeye were delaying in the lower Strait of Georgia. The Panel approved increased run-size estimates for the Early Summer run to 3,800,000 fish (August 9 marine timing) and the Summer run to 5,200,000 fish (August 15 marine timing). The Panel approved several fisheries to harvest available TAC.

September 12 – 18: The marine migration of Fraser sockeye was nearly complete. Assessments continued to indicate that a large number of Late-run sockeye were delaying in the Strait of Georgia. Staff advised the Panel that the run-size of Late-run sockeye could be 20% higher or lower than the adopted estimate, because of uncertainty in projected sockeye abundances during the periods of very high purse seine test fishery catches. The migrations of sockeye past Mission and Hells Gate were strong. Ongoing Panel Area fisheries were scheduled to terminate for the season on September 18.

The Panel relinquished regulatory control of U.S. and Canadian Panel Areas in accordance with the dates specified in the pre-season regulations (Appendix F). In particular, Panel control of the last U.S. area was relinquished on October 2, which under the agreements is therefore the date when most inputs to the TAC calculation are fixed (Table 14).

The Fraser River Panel met for the end-of-season meeting on October 6. The total accounted run in catch and Mission escapement was 28,702,000 fish, which was lower than the adopted in-season estimate of 34,546,000 fish. This result was largely due to in-season estimates of delaying Late-run sockeye abundance in the Strait of Georgia that were considerably higher than subsequent assessments as they migrated upriver past Mission. Late-run sockeye delayed for 13 days prior to migrating into the Fraser River, and because of the later than expected marine migration they passed Mission 7 days later than predicted pre-season. The end-of-season estimate of total catch in all fisheries in 2010 was 13,646,000 Fraser sockeye.

Table 2. Number of days when fishing occurred in Canadian commercial fisheries that targeted Fraser River sockeye salmon in 2010. Regulatory control of Canadian Panel Areas was relinquished by the Panel on September 11 for Area 20, October 2 for Areas 17 and 18, and October 16 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
Jul.18-Jul.24									
Jul.25-Jul.31									
Aug.1-Aug.7						2	2		
Aug.8-Aug.14	5			1	7	5	2	7	
Aug.15-Aug.21	5			1	7	6	4	7	
Aug.22-Aug.28	6			3	7	7	6	7	
Aug.29-Sep.4				4	7	7	7	7	
Sep.5-Sep.11			5	2	7	4	6	7	
Sep.12-Sep.18			2		7			7	
Sep.19-Sep.25									
Total	16	0	7	11	42	31	27	42	0

Table 3. Number of days when fishing occurred in major U.S. net fisheries in the Fraser River Panel Area that targeted Fraser River sockeye salmon in 2010. Regulatory control of U.S. Panel Areas was relinquished by the Panel on September 11 for Areas 4b, 5 and 6c, September 18 for Areas 6, 7 and portions of 7a, and October 2 for the remaining portions of Area 7a, in accordance with pre-season regulations (Appendix F).

Date	Treaty Indian		All Citizen		
	Areas	Areas	Areas 7 and 7A		
	4B, 5, 6C	6, 7, 7A	Purse Seine	Gillnet	Reefnet
Jul.18-Jul.24					
Jul.25-Jul.31	3				
Aug.1-Aug.7	7	2			
Aug.8-Aug.14	7	1	1	1	1
Aug.15-Aug.21	7	2	2	2	2
Aug.22-Aug.28	7	7	1	1	2
Aug.29-Sep.4	7	7	2	2	4
Sep.5-Sep.11	7	7	1	1	7
Sep.12-Sep.18		6			7
Sep.19-Sep.25					
Total	45	32	7	7	23

Table 4. Panel-approved stock monitoring operations (test fishery, hydroacoustic and observer) conducted in 2010.

Area	Location	Gear	Dates	Operated by
Canadian Panel Areas				
20	Juan de Fuca Str.	Gillnet	June 21 - August 15	PSC
20	Juan de Fuca Str.	Purse Seine	July 24 - September 2	PSC
29-1 to 6	Str. of Georgia	Troll	August 16 - September 17	PSC
29-14	Fraser R. (Cottonwood)	Gillnet	July 12 - September 29	PSC
29-16	Fraser R. (Whonnock)	Gillnet	June 22 - October 6	PSC
29-16	Fraser R. (Mission)	Hydroacoustic	June 21 - October 3	PSC
	Fraser R. (Hells Gate)	Observer	July 2 - October 8	PSC
Canadian non-Panel Areas				
12	Queen Charlotte Str. (Round Is.)	Gillnet	July 11 - August 15	DFO
12	Johnstone Str. (Naka Cr.)	Gillnet	July 19 - August 4	DFO
12	Johnstone Str. (Blinkhorn)	Purse Seine	July 24 - September 7	DFO
13	Lower Johnstone Str.	Purse Seine	July 27 - September 3	DFO
United States Panel Areas				
5	Juan de Fuca Str.	Gillnet	July 17 - July 27	PSC
7	San Juan Islands	Reefnet	July 20 - August 16	PSC

IV. MANAGEMENT INFORMATION

To facilitate decision making, the Panel requires information about the abundance, timing, migration route and catch levels of Fraser sockeye salmon by management group. 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 sampling (Mission) and observers (Hells Gate). The locations and schedule for these Staff and DFO programs are listed in Table 4. These data are augmented with information from commercial and First Nations fisheries. Stock identification programs collect and analyze biological samples (e.g., DNA, scales) from various fisheries, which are used primarily to apportion the total abundance of sockeye into component stock groups. Table 5 shows the stock resolution that was reported in 2010.

Table 5. Individual stocks included in the Fraser River sockeye stock groups used in 2010.

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
Late	
Birkenhead *	Birkenhead, Big Silver
Late Shuswap/Portage	{ Lower Adams, Portage, Lower Shuswap, Middle Shuswap, Shuswap Lake, late Eagle
Weaver/Cultus	Weaver, Cultus
Harrison	Harrison, Widgeon

* The Birkenhead stock group was a separate management group in 2009, but in 2010 it was included in the Late-run management group.

These stock monitoring and stock identification data are combined to provide estimates of catch, escapement, daily abundance, migration timing and diversion rate, which are the basis for estimating total abundances, escapement targets and catch allocations for the different management groups. Staff also provide estimates of Management Adjustments (MAs), which are estimates of how many additional fish should be allowed to escape past Mission to increase the likelihood of achieving spawning escapement targets, given historical Differences Between Estimates (DBEs) 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 further information on assessment results such as sockeye abundance, migration timing, diversion rate, management adjustments and DBEs, and Mission escapement.

A. Abundance

The end-of-season estimate of Fraser River sockeye run size adopted by the Panel totalled 34,546,000 Fraser sockeye (Table 1), about three times larger than the median pre-season forecast of 11,439,000 fish. This provided for a very large TAC of 15,771,000 sockeye and extensive fishing opportunities. The post-season estimate (28,265,000 fish, Tables 8 and 9) based on the accounted catch, enumerated spawner abundance and RSA was lower than the end-of-season estimate but 2.5 times larger than the forecast. Post-season estimates were more than twice the p50 (median) forecast for Early Stuart, Summer and Late-run groups, and almost four times the p50 forecast for the Early Summer run.

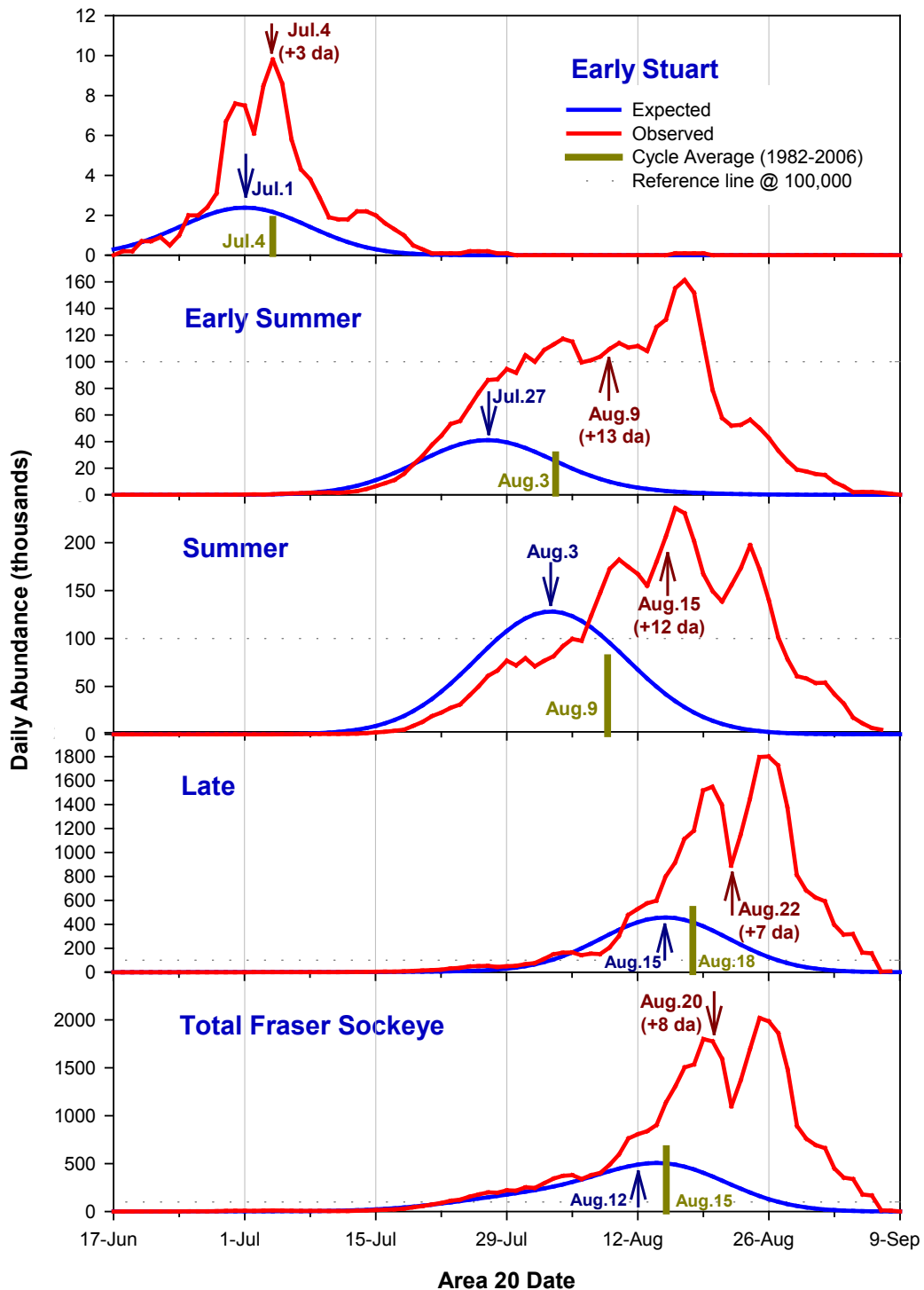


Figure 3. Pre-season projections and post-season reconstructions of daily abundance of Fraser River sockeye salmon in 2010 (Area 20 date), including the observed 50% dates and number of days difference with pre-season expectations. This figure shows the very large abundance and generally late migration of all Fraser sockeye management groups compared to pre-season expectations.

B. Migration Timing and Diversion Rate

Figure 3 shows the mid-point forecast and observed daily migrations, and Area 20 50% migration dates for each sockeye management group and for total Fraser sockeye. End-of-season estimates of marine migration timing in 2010 were later than pre-season expectations. Early Stuart Area 20 timing was 3 days later than forecast, Early Summer timing was 13 days later, Summer-run timing was 12 days later and Late-run timing was 7 days later than expected. The migration dates for these groups were also later than historical averages, except for the Early Stuart group. The Harrison component of the Late run had a 50% Area 20 date of Aug 11, 10 days later than projected.

Late-run stocks (excluding Birkenhead) on this cycle tend to delay longer and migrate upstream later. Since 1998, the mean Late-run delay on this cycle was 14 days. This value was used for pre-season planning, resulting in a pre-season Mission 50% migration date of September 6. In 2006, however, the Late-run delay in the Strait of Georgia was only 4 days. The observed delay (13 days) was one day less than predicted preseason and the actual Mission 50% migration date (September 12) was 6 days later than predicted (September 6) because the marine timing was 7 days later.

Diversion rates in 2010 were considerably higher than forecast for Fraser sockeye. The observed annual diversion through Johnstone Strait was 72% of the Fraser sockeye return, compared to a value of 47% used for pre-season planning (Figure 4). During the in-season period, the relative magnitude of purse seine test fishery sockeye CPUEs in Juan de Fuca Strait versus Johnstone Strait provided an index of short-term diversion rate. The diversion rate was generally low at the beginning of the migration but increased dramatically during the second week of August (Figure 4), before the majority of Summer and Late run sockeye migrated through marine areas. This pattern of increasing diversion rate through the season is typical and when combined with the much larger than expected Late-run return, likely produced the larger than expected annual diversion rate.

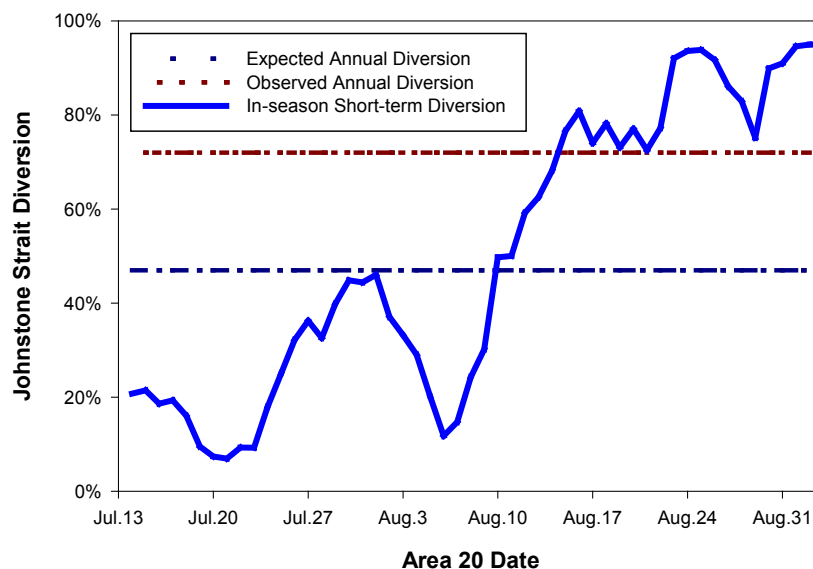


Figure 4. Pre-season expected annual Johnstone Strait diversion for Fraser River sockeye salmon, compared to observed short-term and annual rates estimated during the in-season period.

C. Management Adjustments and DBEs

Management adjustments or MAs are based on statistical models^{5,6,7,8} that consider the historical differences between in-season projections of spawning escapement (i.e., Mission escapement minus catch above Mission, or “potential spawning escapement”) and post-season estimates (i.e., spawning ground enumerations). For Early Stuart, Early Summer and Summer-run stocks the models relate such historical Differences Between Estimates (DBEs) to river conditions measured near Hells Gate in the Fraser River. When discharge levels or temperatures are high, DBEs also tend to be high. In addition, for Early Stuart and Early Summer runs, in-season estimates have been consistently higher than spawning ground estimates even when migration conditions were within normal ranges, and this tendency is also captured by the MA models. For Late-run sockeye, historical DBEs are related to the date when half the run has migrated past Mission (i.e., 50% date), which captures the impact of the early migration behaviour observed since the mid 1990s on their migration success.

While pre-season MAs are based on median values from the historical dataset or on long-range forecasts of river conditions, in-season estimates are derived using pre-season or in-season migration timing estimates, and observed and short-range forecasts of river discharge and temperature levels. In contrast, post-season DBE values are calculated independent of any environmental data using post-season estimates of potential spawning escapement (i.e., Mission escapement minus catch above Mission) and spawning ground estimates.

Table 6. Differences between estimates (DBEs) of potential spawning escapement (Mission escapement minus catch above Mission) and spawning ground abundance estimates. Pre-season predictions are based on long-range forecasts of migration timing and river conditions while in-season estimates are based on in-season observations and short-term projections. The observed DBEs are calculated from end-of-season estimates of potential spawning escapement and enumerated spawning populations.

Description	Early Stuart		Early Summer		Summer		Late	
	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA
Pre-season prediction *	-29%	0.40	-38%	0.62	-3%	0.03	-26%	0.35
In-season prediction **	-7%	0.08	-26%	0.36	-13%	0.15	-26%	0.35
Observed ***	-39%	0.63	-38%	0.62	8%	-0.08	-12%	0.14

* Prediction based on pre-season estimates of migration timing and environmental variables.

** Prediction based on in-season estimates of migration timing and environmental variables.

*** Estimate from Mission-based potential spawning escapement and spawning ground ests.

DBE estimates in the pre-season, in-season and post-season periods are shown in Table 6. In-season estimates were lower than pre-season forecasts for Early Stuart and Early Summer stocks, but higher for Summer-run stocks. Fraser River discharge levels at Hope were low and tracked the mean minus one standard deviation line for most of the season (Figure 5). Fraser River temperatures at Qualark were generally higher than average, however, with a peak temperature of 19.1°C on August 9. This was the peak of the warmest period, during which temperatures tracked the mean plus one standard deviation line for 10 days. Temperatures then dropped close to average for the remainder of the season.

⁵ 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.

⁶ Macdonald, J.S., Patterson, D.A., Guthrie, I.C., and Lapointe, M. 2008. Improvements to environmental management adjustment models: SEF final report.

⁷ Macdonald, J.S., Patterson, D.A., Hague, M.J., and 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.

⁸ 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.

For Late-run sockeye, the Panel agreed to calculate the MA using a fixed pMA of 0.35, unless the Late-run 50% date at Mission was earlier than September 3. In this event the pMA was to be calculated using the timing-based MA model described earlier. The observed Mission date (September 12) was later than September 3, however, so the pre-season pMA remained in effect throughout the season.

Post-season observed DBE estimates were higher than the in-season estimates for Early Stuart and Early Summer groups (Table 6). The post-season Summer-run estimate indicates the observed spawning escapement exceeded the Mission-based PSE estimate by 8%, while for the Late-run group the magnitude of the observed DBE was less than half the forecast amount.

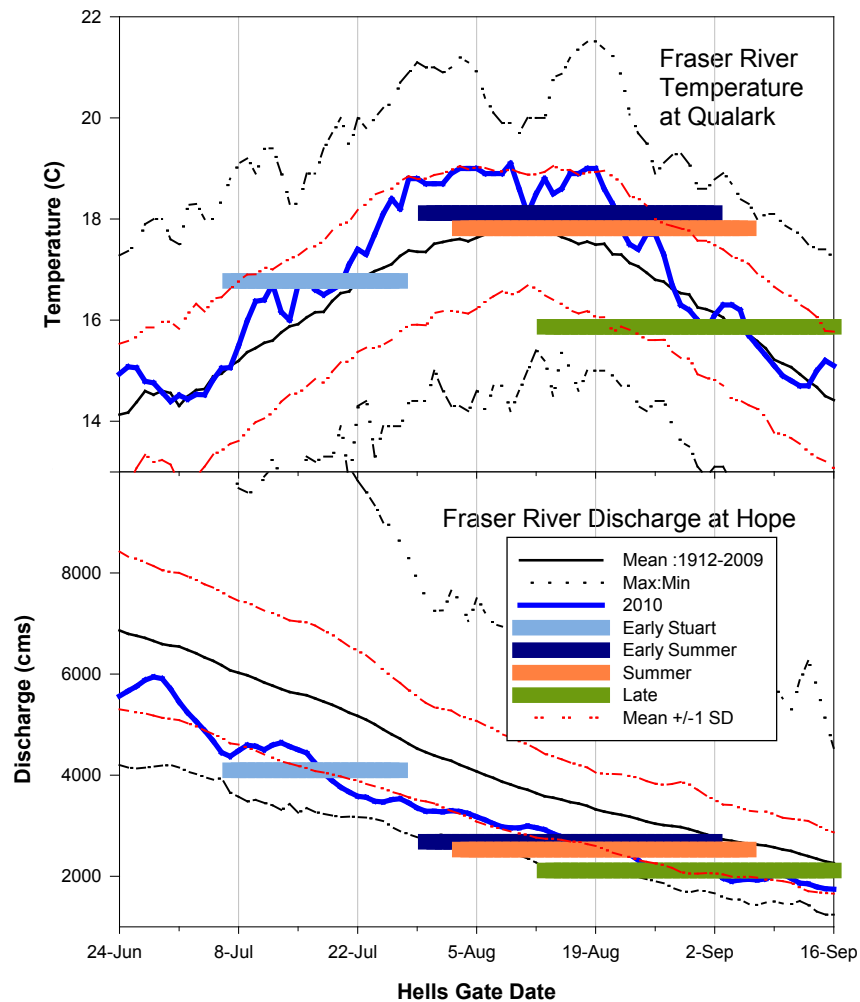


Figure 5. Fraser River temperature and discharge measured near Hope in 2010, with mean temperature and discharge during the central 90% of the migration of each management group (excluding Pitt).

D. Mission Escapement

Estimates of sockeye escapement past Mission are typically generated by the PSC's Mission hydroacoustic program, with additional information provided by in-river test fishery-based estimates of abundance (from CPUE models) when hydroacoustic estimates are unavailable. In 2008, DFO began investigations into the application of DIDSON technology to monitor the passage of sockeye in the Fraser River at Qualark Creek. Mission and Qualark estimates have since been compared, with the estimates showing strong similarities. Because some sockeye populations (e.g., Chilliwack, Harrison, Birkenhead and Weaver stocks) do not migrate as far as Qualark, these stocks are removed from the comparisons. Similarly any in-river catch between the Mission and Qualark sites must be accounted for in the comparisons.

Staff continued these comparisons throughout the season in 2010 and on August 20, Staff reported to the Panel that abundance estimates from the Qualark program were considerably higher than predicted by the Mission program. The persistent pattern of deviations coupled with an inability to completely process data from all sampling platforms deployed at Mission in-season, led Staff to recommend that the Panel use estimates of daily passage of sockeye at Mission that were scaled by the ratio of Qualark to Mission daily abundance estimates, with a 2-day lag in August and a 3-day lag in September. At the end of the season, the total sockeye abundance expected to reach Qualark based on unadjusted Mission estimates was almost 11,000,000 sockeye, compared to 14,000,000 sockeye estimated by the Qualark program. The total rescaled Mission estimate was very similar to the Qualark total, with minor temporal differences (Figure 6).

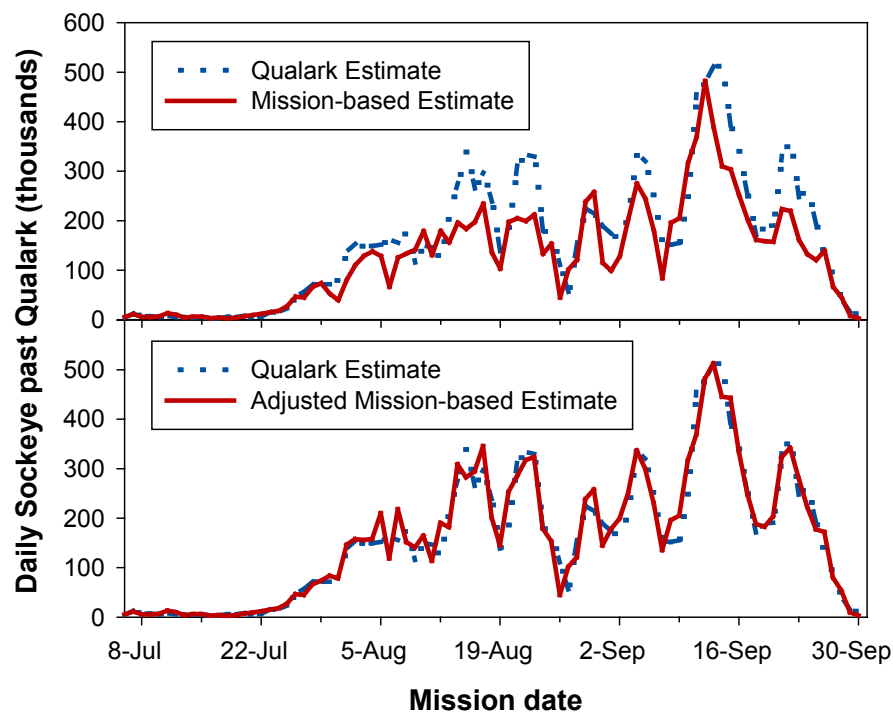


Figure 6. Estimates of sockeye salmon passage at Qualark based on Qualark hydroacoustic data compared to estimates based on unadjusted (top) and adjusted (bottom) Mission hydroacoustic data.

Mission escapement based on the adjusted estimates totalled 16,336,000 sockeye, including 101,000 Early Stuart, 2,702,000 Early Summer, 3,148,000 Summer and 10,385,000 Late-run sockeye (Table 7).

Table 7. End-of-season estimates of Fraser River sockeye passage at Mission in 2010. These values reflect adjustments that were performed to harmonize abundance estimates from the Mission and Qualark hydroacoustic programs.

Management Group Stock Group	Mission Passage	
	fish	%
Early Stuart	100,800	1%
Early Summer	2,702,100	17%
Chilliwack	10,700	0%
Early Miscellaneous	55,900	0%
Seymour/Scotch	2,511,300	15%
North Thompson	87,300	1%
Pitt *	36,900	0%
Summer	3,148,400	19%
Chilko	2,476,800	15%
Quesnel	363,500	2%
Late Stuart/Stellako	308,100	2%
Late	10,384,600	64%
Birkenhead	167,500	1%
Late Shuswap/Portage	8,770,600	54%
Weaver/Cultus	393,400	2%
Harrison	1,053,100	6%
Total	16,335,900	100%

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

V. RUN SIZE, CATCH AND SPAWNING ESCAPEMENT

Table 8 provides an overview of run size by management group for Fraser sockeye salmon. Included are estimates of catches, spawning escapements and Run-size Adjustments (RSAs)⁹. Table 9 provides similar information, but with more detail on individual sockeye stock groups. For a historical perspective Figure 7 shows total annual sockeye abundance and spawner abundance since 1893, while Figure 8 shows annual catch, escapement and exploitation rate since 1986. Details of commercial catch distributions of Fraser sockeye by area and gear in Canada and the U.S. are provided in Tables 10 and 11. Table I1 in Appendix I shows catch by user group, spawning escapement, RSA and total abundance over the last four cycle years, while Table I2 in Appendix I shows a geographic breakdown of Canadian First Nations catches, including in FSC, EO and Demo fisheries. Escapements by management group since 1938 are summarized in Figure 10, and by stock for the last four cycle years in Table I3 in Appendix I.

⁹ Run-size Adjustments (RSAs) are 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, incomplete catch estimates or incomplete spawning ground assessments. 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 are collaborating in the development of a formal process and criteria for determining RSAs.

Table 8. Catch, escapement, run-size adjustment, abundance and exploitation rate estimates for Fraser River sockeye salmon by management group in 2010.

	Fraser Sockeye				Total	% of Run
	Early Stuart	Early Summer	Summer	Late		
CANADIAN CATCH	3,500	993,800	1,965,900	8,606,000	11,569,200	41%
Commercial Catch	600	582,400	1,311,400	7,349,200	9,243,700	33%
Panel Area	300	314,300	552,100	2,592,400	3,459,100	12%
Non-Panel Areas	300	268,100	759,400	4,756,800	5,784,600	20%
First Nations Catch	2,800	368,400	591,700	1,052,200	2,015,100	7%
Marine FSC	80	64,600	73,600	170,300	308,500	1%
Fraser River FSC	2,700	164,700	276,100	126,600	570,100	2%
Economic Opportunity	30	139,100	242,000	755,400	1,136,500	4%
Non-commercial Catch	60	43,000	62,800	204,500	310,400	1%
Marine Recreational	0	4,100	7,400	69,000	80,500	0%
Fraser Recreational	0	37,100	53,400	122,200	212,800	1%
Charter	60	1,900	1,900	2,800	6,600	0%
ESSR	0	0	0	10,500	10,500	0%
UNITED STATES CATCH	300	226,700	386,300	1,346,300	1,959,500	7%
Washington Total	300	226,700	386,300	1,346,300	1,959,500	7%
Commercial catch	300	222,500	381,700	1,340,700	1,945,100	7%
Treaty Indian	200	133,500	240,800	828,000	1,202,600	4%
All Citizen	60	88,900	140,900	512,700	742,500	3%
Non-commercial Catch	30	4,200	4,700	5,600	14,400	0%
Ceremonial	30	4,200	4,700	5,600	14,400	0%
Recreational	0	0	0	0	0	0%
Alaska	0	0	0	0	0	0%
TEST FISHING CATCH	2,400	21,700	18,400	29,500	71,900	0%
PSC (Panel Areas)	200	8,600	7,200	11,000	27,000	0%
Canada	30	5,300	4,400	8,100	17,800	0%
United States	100	3,300	2,800	2,900	9,200	0%
Canada (non-Panel Areas)	2,200	13,100	11,200	18,500	44,900	0%
TOTAL RUN	104,900	3,002,600	5,756,000	19,401,300	28,264,700	100%
Total Catch in All Fisheries	6,100	1,242,200	2,370,600	9,981,800	13,600,600	48%
Adult Spawning Escapement *	60,300	1,529,800	2,990,500	8,550,300	13,130,900	46%
Jack Spawning Escapement *	0	6,700	3,100	2,300	12,100	0%
Run-Size Adjustment	38,500	223,900	391,800	866,900	1,521,100	5%
Percentage of Total Run	100%	100%	100%	100%	100%	
Total Catch in All Fisheries	6%	41%	41%	51%	48%	
Spawning Escapement	57%	51%	52%	44%	46%	
Run-Size Adjustment	37%	7%	7%	4%	5%	

* Spawner estimates for Cultus sockeye include 342 adults and 15 jacks captured as broodstock.

The post-season estimate of total Fraser sockeye abundance in 2010 was 28,265,000 fish (Tables 8 and 9), 2.5 times the median forecast (Table 1), very close to the 90% probability level forecast of 29,827,000 fish (Table B1 in Appendix B) and more than double the brood year abundance (12,982,000 fish in 2006, Table I1 in Appendix I). It was the largest return on the 2010 cycle since records began in 1893 and the largest return on any cycle since 1913 (Figure 7).

The abundant returns were spread across all management groups. The total return of Early Stuart sockeye was 105,000 adults (Tables 8 and 9), or 2.5 times the median forecast. Early Summer-run returns (primarily Scotch/Seymour stocks) totalled 2,996,000 adult sockeye, 3.8 times the forecast. The abundance of Summer-run sockeye was 5,753,000 adults, or 2.2 times the pre-season forecast. The return of 19,399,000 adult Late-run sockeye was 2.4 times the forecast.

Table 9. Catch, escapement, run-size adjustment, abundance and exploitation rate estimates for Fraser River sockeye salmon by stock group in 2010.

Management Group Stock Group	Adult			Abundance			Portion of Run	Adult Exploitation Rate
	Catch	Spawning Escapement	Run-size Adjustment	Adult	Jack ¹	Total		
Early Stuart	6,100	60,300	38,500	104,900	0	104,900	0%	6%
Early Summer	1,242,200	1,529,800	223,900	2,995,900	6,700	3,002,600	11%	41%
Chilliwack	900	2,800	0	3,600	20	3,700	0%	25%
Early Miscellaneous	29,900	57,400	12,200	99,500	6,700	106,200	0%	30%
Seymour/Scotch	1,165,000	1,428,800	176,600	2,770,400	0	2,770,400	10%	42%
North Thompson	43,600	24,000	35,100	102,700	0	102,700	0%	42%
Pitt	2,800	16,800	0	19,600	0	19,600	0%	14%
Summer	2,370,600	2,990,500	391,800	5,752,900	3,100	5,756,000	20%	41%
Chilko	1,797,000	2,459,900	304,000	4,561,000	3,000	4,564,000	16%	39%
Quesnel	329,500	250,900	31,000	611,400	20	611,400	2%	54%
Late Stuart/Stellako	244,000	279,700	56,800	580,500	70	580,500	2%	42%
Late	9,981,800	8,550,300	866,900	19,399,000	2,300	19,401,300	69%	51%
Birkenhead	180,000	140,900	19,200	340,100	200	340,300	1%	53%
Late Shuswap/Portage	9,339,200	7,576,900	589,300	17,505,300	60	17,505,400	62%	53%
Weaver/Cultus ²	135,400	69,900	43,300	248,600	2,000	250,600	1%	54%
Harrison	327,200	762,700	215,100	1,305,000	0	1,305,000	5%	25%
Total	13,600,600	13,130,900	1,521,100	28,252,600	12,100	28,264,700	100%	48%
Portion of Total Run	48%	46%	5%	100%	0%	100%		

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

² Spawning escapement estimates for Cultus sockeye include 342 adults and 15 jacks captured as broodstock.

The very large returns in 2010 are in stark contrast to the record low productivity that affected sockeye returns in 2009 and which resulted in the Government of Canada establishing the “Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River”, otherwise known as the Cohen Commission (www.cohencommission.ca). Thus, these returns signal a relief from the recent trend towards poor marine survival and low productivity of Fraser sockeye.

The total catch of 13,601,000 fish was about 48% of the run (Tables 8 and 9), and the largest catch since the years of high Fraser sockeye returns in the early 1990s. This exploitation rate is within the historical range observed since the mid 1990s, when exploitation rates were generally reduced (Figure 8). Of the total catch, 11,569,000 fish were caught in Canada, 1,960,000 fish in the U.S. and 72,000 fish in test fisheries.

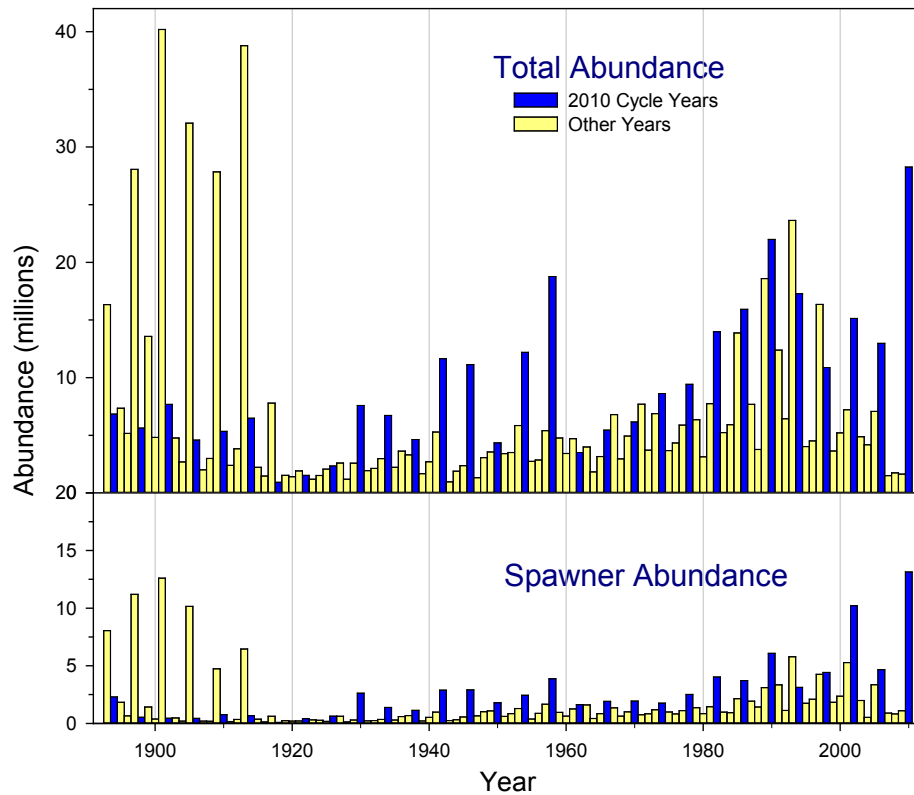


Figure 7. Total abundance (top) and adult spawner abundance (bottom) of Fraser River sockeye salmon between 1893-2010. Returns on the 2010 cycle are emphasized.

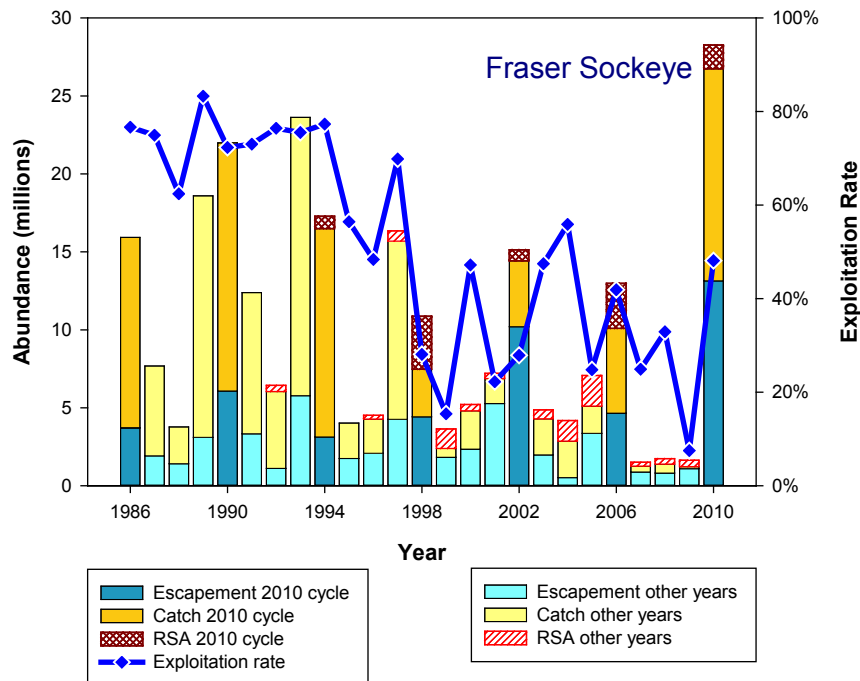


Figure 8. Total abundance, catch, escapement, run-size adjustment (RSA) and exploitation rate for Fraser River sockeye salmon between 1986-2010, with returns on the 2010 cycle emphasized.

Table 10. Canadian commercial catches of Fraser River sockeye salmon by user group, gear type, license designation and statistical fishery area during the 2010 fishing season. 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	5,804,300	0	1,001,600	2,086,000	0	0	351,700	9,243,700
Panel Areas	0	1,276,600	0	0	2,086,000	0	0	96,500	3,459,100
20		127,900			0		0		127,900
17, 18, 29		1,148,700			2,086,000			96,500	3,331,200
121-124 *		0			0		0		0
Non-Panel Areas	0	4,527,700	0	1,001,600	0	0	0	255,200	5,784,600
1-10	0		0			0			0
11-16		4,527,700		1,001,600	0		0	255,200	5,784,500
124-127 *							0		0
First Nations Economic Opportunity and Demo Fisheries									1,136,500
Total Catch									10,380,200

* 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 during the 2010 fishing season. *

Areas	Troll	Purse Seine	Gillnet	Reefnet	Total
Panel Area (Washington) *	0	1,178,800	733,500	32,800	1,945,100
Treaty Indian *	0	614,900	587,600	0	1,202,600
4B, 5 and 6C	0	0	132,400	0	132,400
6 and 7	0	534,000	140,000	0	674,000
7A	0	80,900	315,300	0	396,200
All Citizen **	0	563,800	145,800	32,800	742,500
7	0	455,100	67,200	32,800	555,100
7A	0	108,800	78,600	0	187,400
Alaska (District 104) Catch					0
United States Total					1,945,100

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

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

DFO annually assesses the abundance of sockeye spawning populations in the Fraser watershed (Figure 9). In 2010, the near-final estimate of adult spawners (primarily age 4 and age 5 fish) totalled 13,131,000 fish, or 46% of the total run. This escapement was 2.8 times the brood year (2006) escapement of 4,661,000 adults and the largest escapement since at least 1893 (Figure 7). Increased escapements relative to the brood year were observed across all management groups, but in particular adult Early Summer and Summer-run escapements were almost 4 times the brood year escapement.

A long term view shows that escapements on the 2010 cycle have historically been high for Late-run sockeye (2010 is the dominant cycle line), moderate for Early Summer and Summer-run groups, and low for Early Stuart sockeye (Figure 10). In a historical cycle-line context, spawning escapements in 2010 represent the: (1) largest Early Stuart escapement on the 2010 cycle since 1990; (2) largest Early Summer escapement by far on any cycle since at least 1938; (3) similar Summer-run escapement as other cycle years between 1990-2002; and (4) largest Late-run escapement on any cycle since at least 1938.

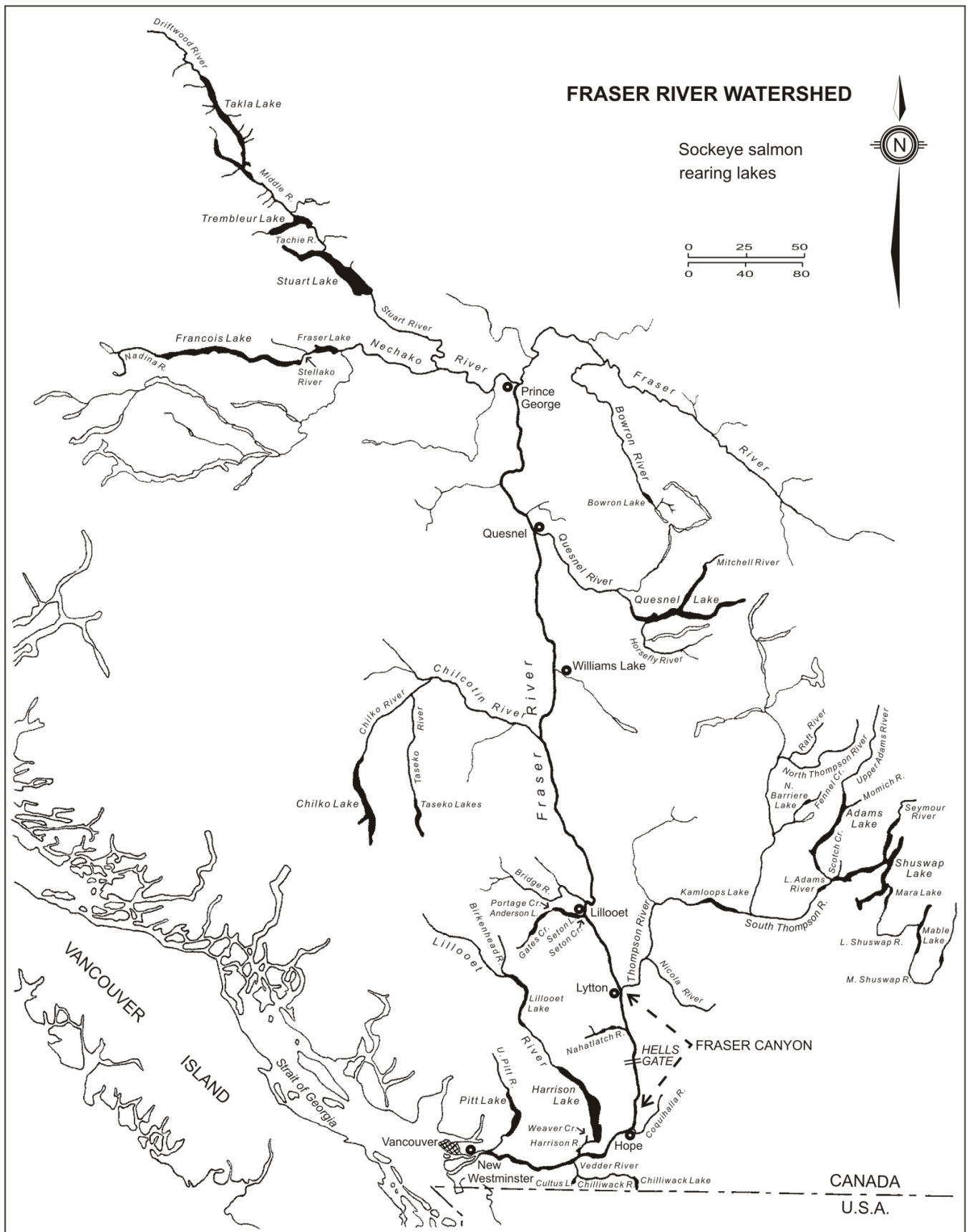


Figure 9. Sockeye salmon spawning grounds in the Fraser River watershed.

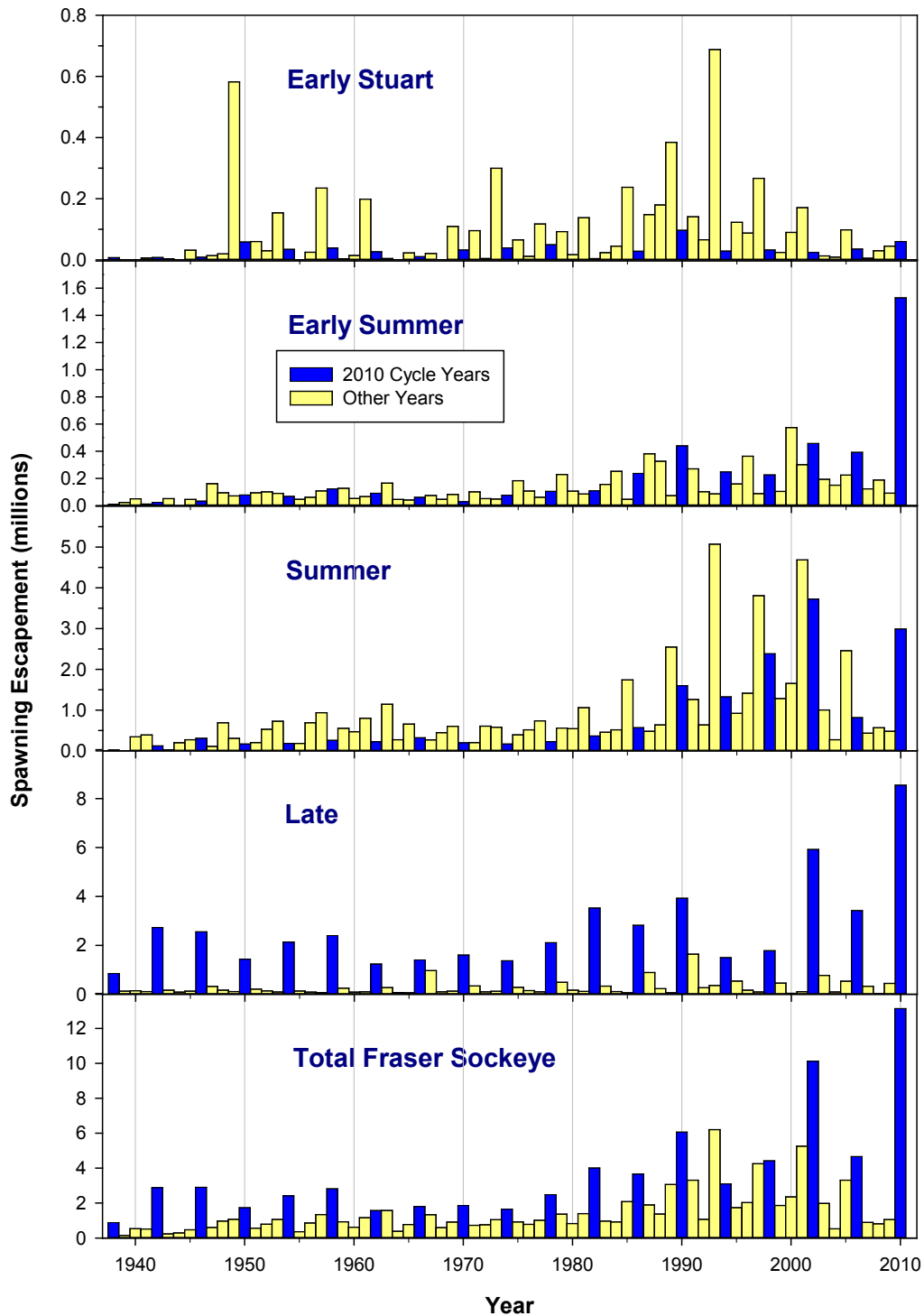


Figure 10. Adult spawning escapement of Fraser River sockeye salmon by year (1938-2010) for each management group, with escapements on the 2010 cycle emphasized.

The overall spawning success of adult female sockeye in the Fraser watershed was only 80%, the second lowest on the 2010 cycle since at least 1938 and similar to the last two cycle years. The effective female spawning population in 2010 totalled 5,832,000 fish, 2.8 times the effective female escapement in 2006.

The RSA estimate was 1,521,000 fish, or 5% of the total return (Tables 8 and 9). As a percentage of the run size of each management group, Early Stuart had the largest RSA (37%), while the other groups had RSAs in the 4-7% range. The methods for determining RSAs are under review by PSC and DFO staff, and the Fraser Technical Committee.

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 (Table B2 in Appendix B) to abundance estimates for each management group.

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 after the fishing season has ended. In-season management is therefore based on targets for potential spawning escapement (PSE), which include MAs in addition to spawning escapement targets and can be monitored in-season. As the season progresses these PSE targets are compared against in-season PSE estimates, which are calculated as Mission escapements to date minus First Nations, recreational and other catches above Mission.

Table 12. Comparison of in-season potential spawning escapement (PSE) target (i.e., spawning escapement target plus MA) and in-season PSE estimate (i.e., Mission escapement minus catch above Mission) for adult Fraser River sockeye salmon in 2010.

Management Group	Final	Potential Spawning Escapement					
	In-season	Spawning Escapement Target	Management Adjustment *	In-season	In-season	Difference	
	Abundance Estimate			PSE Target **	PSE Estimate ***		
Adult sockeye	34,546,000	13,881,400	4,429,300	18,302,300	15,036,000	-3,266,300	-18%
Early Stuart	105,000	105,000	8,400	105,000	98,300	-6,700	-6%
Early Summer	3,800,000	1,520,000	547,200	2,067,200	2,481,600	414,400	20%
Summer	5,200,000	2,080,000	312,000	2,392,000	2,759,500	367,500	15%
Late	25,441,000	10,176,400	3,561,700	13,738,100	9,696,600	-4,041,500	-29%

* Adjustment to spawning escapement target to achieve spawning escapement goal. If the PSE target exceeds the total abundance, then the target equals the total abundance.

** Spawning escapement target + management adjustment.

*** Mission escapement estimate minus all catch above Mission.

Based on final in-season PSE estimates, in-season PSE targets were exceeded for Early Summer (20% over) and Summer-run sockeye (15% over, Table 12), but in-season PSE estimates fell short of the targets for Early Stuart (6% under) and Late-run stocks (29% under). In the case of Early Stuart, the shortfall was mostly due to catch in First Nations and test fisheries (Table 8). For Late-run sockeye the in-season PSE target was unrealistically high given that the more certain

post-season run-size estimate (19,401,000 fish, Table 8) was much lower than the in-season estimate (25,441,000 fish, Table 1). In-season estimates of catch-to-date remained below the available harvest-to-date throughout the season (Table 1, Figure 11).

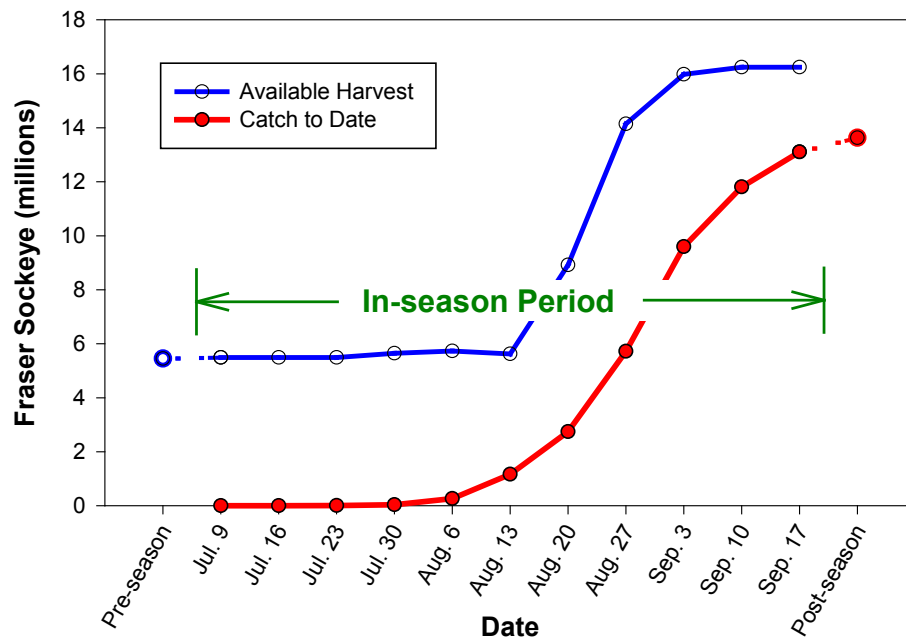


Figure 11. Comparison of available harvest and catch to date of Fraser sockeye in all fisheries in 2010. The available harvest represents the number of fish that are surplus to spawning escapement requirements and are calculated as run size minus spawning escapement target and management adjustment. It therefore includes fish that are available for catch in all commercial, recreational, First Nations and test fisheries.

In terms of the achievement of post-season objectives, the total spawning escapement of Fraser sockeye was well above (15% over) the post-season spawning escapement target (Table 13). Targets were exceeded for Early Summer (27% over), Summer (30% over) and Late-run sockeye (10% over). The spawning escapement of Early Stuart sockeye, however, fell short of the target by 43%, primarily because the target was the entire run (Table 13) and the observed DBE (39%, Table 6) made the target unattainable. A bycatch of 6,100 Early Stuart sockeye in a variety of fisheries (Table 8) also contributed to the shortfall.

Table 13. Comparison of post-season spawning escapement targets and upriver escapement estimates for adult Fraser River sockeye salmon in 2010. Upriver estimates of sockeye spawners are from spawning ground enumeration programs (DFO).

Management Group	Post-season Abundance Estimate	Spawning Escapement			
		Post-season Target	Adult Estimate	Difference	
				Fish	%
Sockeye salmon	28,264,700	11,368,900	13,130,900	1,762,100	15%
Early Stuart	104,900	104,900	60,300	-44,600	-43%
Early Summer	3,002,600	1,201,000	1,529,800	328,800	27%
Summer	5,756,000	2,302,400	2,990,500	688,100	30%
Late	19,401,300	7,760,500	8,550,300	789,800	10%

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 and the February 11, 2010 Commission Guidance (Appendix C), the TAC calculations are based on the run sizes, spawning escapement targets, MAs and Aboriginal Fishery Exemptions in effect when the Panel relinquished control of the last U.S. Panel Area (October 2 in 2010).

Table 14. Summary calculation of the achievement of the Total Allowable Catch (TAC) of Fraser River sockeye salmon in 2010. These 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 2), in accordance with Annex IV of the Treaty and the February 11, 2010 Commission Guidance.

		<u>Sockeye</u>
TOTAL ALLOWABLE CATCH		
In-season Total Run Size		34,546,000
Deductions		18,782,600
In-season Spawning Escapement Target		13,881,400
In-season Management Adjustment		4,429,300
Aboriginal Fishery Exemption (AFE)		400,000
Post-season Test Fishing Catch		71,900
Total Allowable Catch	1, 2	15,776,900
UNITED STATES		
Washington Share		2,598,900
Washington Share of TAC	1, 3	2,603,200
Payback		-4,300
Washington Catch		1,959,500
Deviation		639,400
In-season Alaska Catch Estimate		0
CANADA		
Balance to Canada + U.S. Payback + AFE		13,578,000
Canadian Catch excluding ESSR Catch		11,558,700
Deviation		2,019,300
1	TAC and Washington sockeye share according to Annex IV of the Pacific Salmon Treaty and Feb. 11, 2010, 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 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).	

With the total in-season abundance estimate of 34,546,000 Fraser sockeye, minus deductions for spawning escapement, MA, test fishing catch and AFE, the TAC in 2010 was 15,777,000 sockeye and the U.S. share was 2,599,000 (Table 14, Table I4 in Appendix I). The U.S. catch was 639,000 sockeye less than their share of the TAC, while the total catch in all fisheries was 2,659,000 sockeye less than the overall TAC.

C. Domestic Allocation

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

With respect to domestic allocations of Fraser sockeye salmon, Treaty Indian fishers in the U.S. caught 541,000 fish less than their share of the TAC and All Citizen fishers caught 98,000 fish less than their share (Table 15).

Table 15. Achievement of domestic catch allocation objectives for Fraser sockeye salmon in the U.S. (Washington).

User Category	Actual Catch		U.S. Share		Deviation
	Fish	%	Fish	%	
Washington Total	1,959,500	100.0%	2,598,900	100.0%	-639,400
Treaty Indian *	1,217,000	62.1%	1,758,066	67.6%	-541,100
All Citizen **	742,500	37.9%	840,834	32.4%	-98,300

* Treaty Indian catch includes commercial and ceremonial catches.

Treaty Indian share = 67.7% of U.S. TAC minus the 4,300 U.S. payback.

** All Citizen catch includes commercial and recreational catches.

All Citizen share = 32.3% of U.S. share of TAC.

D. Conservation of Other Stocks and Species

Catches of non-target stocks and species in Panel-managed fisheries directed at Fraser River sockeye salmon (Table 16) were small in 2010 relative to the sockeye catch. By-catches of non-Fraser salmon in commercial net fisheries regulated by the Fraser River Panel totalled 20,200 sockeye and 2,200 pink salmon. Catches of other Fraser and non-Fraser salmon species included 8,700 chinook, 4,800 coho, 400 chum salmon and zero steelhead.

Table 16. Catch of non-Fraser sockeye and pink salmon and of other salmon species in commercial fisheries regulated by the Fraser River Panel in 2010.

Area and Gear	Non-Fraser		Fraser and Non-Fraser			
	Sockeye	Pink	Chinook	Coho	Chum	Steelhead
United States *	17,820	1,970	8,670	4,750	359	0
Areas 4B, 5 and 6C Net	1,250	1,120	1,910	2,390	175	0
Areas 6, 7 and 7A Net	16,570	853	6,760	2,360	184	0
Canada **	2,380	236	8	19	43	0
Area 20 Net	1,880	158	0	5	2	0
Area 29 Net	247	59	3	14	39	0
Area 18, 29 Troll	247	19	5	0	2	0
Total	20,200	2,210	8,680	4,770	402	0

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

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

** Estimates from DFO in-season hail program.

VII. ALLOCATION STATUS

By Panel agreement there are no paybacks to carry forward to future years (Table 17).

Table 17. Allocation status of Fraser River sockeye salmon for 2006-2010. After 2010, no payback was due for Fraser sockeye salmon.

	Fraser Sockeye				
	2006	2007	2008	2009	2010
TOTAL ALLOWABLE CATCH					
Total Run Size	8,715,000	1,428,000	1,715,000	1,370,000	34,546,000
Escapement and other deductions	6,457,000	1,428,000	1,369,700	1,370,000	18,769,100
Total Allowable Catch:	2,258,000	0	345,300	0	15,776,900
UNITED STATES					
Washington Catch	708,000	3,400	49,400	4,300	1,959,600
Washington Share (exclds payback) *	373,000	0	57,000	0	2,603,200
Deviation:	335,000	3,400	-7,600	4,300	-643,600
Cumulative Allocation Status:	0 **	3,400	0 **	4,300	0 **
CANADA					
Catch	4,565,000	197,000	481,100	73,800	11,558,700
Balance + Aboriginal Fishery Exemption	2,285,000	197,000	688,300	146,800	13,573,700
Deviation:	2,280,000	0	-207,200	-73,000	-2,015,000

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

2006: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks. By agreement (Feb. 14, 2008), no paybacks were carried forward.

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 were carried forward.

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.

** 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.

Demonstration (Demo) fishery: Commercial Fraser River First Nations fishery in BC Interior area.

Difference between estimates (DBE): Difference between estimates of potential spawning escapement (PSE) and spawning escapement. 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.

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

ESSR: Terminal harvest of Weaver Creek sockeye that are "Excess Salmon to Spawning Requirements".

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 First Nations fishery to harvest fish for Food, Social and Ceremonial purposes.

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 and Late-run groups.

Migration date or 50% date: Date when half (50%) of the total abundance of a specified group of fish 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 escapement is primarily estimated by hydroacoustic methods, but at times (early and late in the season) is supplemented by expanded CPUE estimates derived from in-river test fisheries or adjustments from other hydroacoustic programs (i.e., Qualark).

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 all catch above Mission. If there were no en route mortalities or estimation errors in Mission escapement, up-river catches, spawning escapement or stock identification, the potential spawning escapement would in theory equal the enumerated spawning populations.

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, incomplete catch estimates, 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	p: Probability
DIDSON: Dual-frequency IDentification SONar	pMA: Proportional Management Adjustment
EO: Economic Opportunity	PSC: Pacific Salmon Commission
ESSR: Excess Salmon to Spawning Requirements	PSE: Potential spawning escapement
FRP: Fraser River Panel	RSA: Run-size Adjustment
FRPTC: Fraser River Panel Technical Committee	SE: Spawning Escapement
FSC: “Food, social and ceremonial”	SET: Spawning Escapement Target
GSI: Genetic Stock Identification	TAC: Total Allowable Catch
	TAM: Total Allowable Mortality
	WDFW: Washington Department of Fish and Wildlife

APPENDIX B: 2010 PRE-SEASON FORECASTS AND SPAWNING ESCAPEMENT TARGETS FOR FRASER RIVER SOCKEYE SALMON

Table B1. Pre-season forecast of the 2010 Fraser River sockeye salmon return that incorporates recent productivity trends¹⁰. (Provided to the Panel by Fisheries and Oceans Canada).

Sockeye stock/timing group	Mean Run Size		Probability of Achieving Specified Run Sizes ^a				
	all cycles ^b	2010 cycle ^c	10%	25%	50%	75%	90%
Early Stuart	304,000	113,000	17,000	26,000	41,000	66,000	101,000
Early Summer	--	--	174,000	374,000	783,000	1,601,000	3,047,000
<i>(total excluding miscellaneous)</i>	<i>(504,000)</i>	<i>(797,000)</i>	<i>(129,000)</i>	<i>(269,000)</i>	<i>(581,000)</i>	<i>(1,251,000)</i>	<i>(2,543,000)</i>
Bowron	21,000	20,000	400	700	1,300	2,500	4,600
Fennell	29,000	26,000	9,000	16,000	31,000	56,000	90,000
Gates	59,000	17,000	2,000	4,000	9,000	17,000	33,000
Nadina	79,000	22,000	9,000	16,000	30,000	60,000	107,000
Pitt	60,000	55,000	7,000	12,000	26,000	53,000	96,000
Raft	33,000	16,000	7,000	13,000	24,000	42,000	71,000
Scotch	73,000	248,000	40,000	106,000	265,000	640,000	1,450,000
Seymour	150,000	393,000	55,000	101,000	195,000	380,000	691,000
Misc ^d	--	--	13,000	58,000	134,000	242,000	302,000
Misc ^e	--	--	7,000	10,000	14,000	22,000	42,000
Misc ^f	--	--	24,000	35,000	48,000	76,000	144,000
Misc ^g	--	--	1,000	1,000	4,000	6,000	10,000
Misc ^h	--	--	0	1,000	2,000	4,000	6,000
Summer	5,332,000	5,059,000	1,045,000	1,605,000	2,612,000	4,343,000	6,984,000
Chilko	1,740,000	1,900,000	864,000	1,273,000	1,958,000	3,011,000	4,435,000
Late Stuart	750,000	396,000	8,000	21,000	60,000	169,000	429,000
Quesnel ^j	2,350,000	2,200,000	111,000	215,000	438,000	909,000	1,727,000
Stellako	492,000	563,000	62,000	96,000	156,000	254,000	393,000
Late	3,193,000	9,126,000	3,331,000	5,023,000	8,003,000	12,305,000	19,695,000
<i>(total excluding miscellaneous)</i>	<i>(3,193,000)</i>	<i>(9,126,000)</i>	<i>(3,264,000)</i>	<i>(4,951,000)</i>	<i>(7,871,000)</i>	<i>(12,035,000)</i>	<i>(19,352,000)</i>
Cultus	17,000	18,000	5,000	6,000	9,000	14,000	19,000
Harrison	58,000	NA	53,000	97,000	195,000	429,000	1,167,000
Late Shuswap	2,210,000	7,640,000	3,101,000	4,652,000	7,252,000	10,791,000	16,702,000
Portage	55,000	90,000	8,000	18,000	42,000	99,000	221,000
Weaver	406,000	690,000	71,000	126,000	264,000	472,000	799,000
Birkenhead	447,000	688,000	26,000	52,000	109,000	230,000	444,000
Misc. non-Shuswap ⁱ	-	-	67,000	72,000	132,000	270,000	343,000
TOTAL	-	-	4,567,000	7,028,000	11,439,000	18,315,000	29,827,000
<i>(TOTAL excluding miscellaneous)</i>	<i>(9,333,000)</i>	<i>(15,095,000)</i>	<i>(4,455,000)</i>	<i>(6,851,000)</i>	<i>(11,105,000)</i>	<i>(17,695,000)</i>	<i>(28,980,000)</i>

a. probability that return will be at/or below specified projection.

b. sockeye: 1980-2006 (excluding miscellaneous stocks)

c. sockeye: 1980-2008 (excluding miscellaneous stocks)

d. unforecasted mis. Early Summer Stocks (Early Shuswap stocks: S.Thompson); return timing most similar to Scotch/Seymour.

e. unforecasted misc. Early Summer stocks (N. Thomson tributaries; return timing most similar to Fennell/Bowron/Nadina).

f. North Thompson River

g. Nahatlach River & Lake

h. Chilliwack Lake and Dolly Varden Creek

i. unforecasted miscellaneous Late Run stocks (Harrison)

¹⁰ DFO, 2010. Pre-season run size forecasts for Fraser River Sockeye salmon in 2010. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/031.

Table B2. Fraser River sockeye salmon escapement plan (in thousands of fish) for 2010 based on p50 pre-season forecast that incorporates recent productivity trends (extracted from DFO's Southern B.C. Salmon Integrated Fishery Management Plan.¹¹)

Stock Group	Run Size Estimate of Forecasted Stocks	Run Size Reference Points	Total Mortality Rate Guidelines	Total Allowable Mortality at Run Size	Escapement Target at Run Size	Management Adjustment	Exploitation Rate after MA (b)
Early Stuart	41	- 156 390	156 390 0-60% 60%	0% 60%	41	63% 26	0%
Early Summer	783	- 270 674	270 674 0-60% 60%	60%	313	51% 160	40%
Summer	2,612	- 1,000 2,500	1,000 2,500 0-60% 60%	60%	1,045	7% 73	57%
Late	8,003	- 1,220 3,050	1,220 3,050 0-60% 60%	60%	3,201	66% 2,113	34%
Cultus	9						20-30% (c)
Sockeye Totals	11,439				4,600	2,372	
Cultus	<i>Est. Return</i>						

a) Management adjustments (MAs) are added to the escapement targets to correct for the actual differences between Mission and upstream abundance estimates over all years. This approach makes no prior assumption about environmental conditions because we don't yet know whether conditions will be favourable or unfavourable in 2010. We expect that the MAs will be revised to take into account an environmental conditions during the in-season management period.

b) A fixed ER floor of up to a maximum of 10% for all stock groups is in place to allow for the harvest of co-migrating stocks and or species in cases when the total allowable mortality n management adjustment results in an exploitation rate of less than 10%. Test fishing impacts will be included as part of the 10% maximum ER floor. The 10% fixed ER floor is to allow for fisheries targeted on more abundant co-migrating stocks and not intended for directed harvest opportunities on that run timing group nor is it intended to be an additional ER limit based on the escapement plan TAM rules

c) Cultus Lake exploitation will be limited to a maximum of up to 30%, without exceeding the exploitation rate implemented for the Late run sockeye management aggregate.

¹¹ 2010/2011 Southern B.C. Salmon Integrated Fishery Management Plan. Fisheries and Oceans Canada.

APPENDIX C: COMMISSION GUIDANCE TO THE FRASER RIVER PANEL (agreed February 11, 2010)

February 11, 2010

Commission Guidance to the Fraser River Panel

For 2010 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 re-distributed 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 pre-season 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: 2010 FRASER RIVER PANEL MANAGEMENT PLAN PRINCIPLES AND CONSTRAINTS (agreed June 10, 2010)

1. Fisheries and Oceans Canada (DFO) has provided the Panel with run-size forecasts for Fraser River sockeye salmon by run timing group. DFO stated that the Fraser River sockeye run-size forecasts remain highly uncertain and vary depending on the assumptions underlying the forecast methods. To put the 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 7,028,000 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 18,315,000 fish. For pre-season planning purposes, the Panel used the 50% probability levels of abundance for the forecasted sockeye stocks. There is a 50% probability that the total Fraser sockeye salmon return will reach or exceed 11,439,000 fish.
2. The Panel's first priority in 2010 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, will be 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 11, 2010 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% p levels of abundance, for the purposes of computing TAC by stock management grouping in 2010, the Panel agreed that the Fraser River Aboriginal Exemptions were as follows: Early Stuart sockeye, 4,100 fish, Early Summer-run sockeye, 41,600 fish; Summer-run sockeye, 228,500 fish; and Late-run sockeye, 125,800 fish. There is no available harvest of Early Stuart sockeye at the 50% p level forecast of abundance. Canada's objective will be to protect 90% of the Early Stuart return, while allowing for some harvest of co-migrating stocks and/or species. As per Fraser Panel agreement, for the 2010 season the United States owes a payback of 4,400 Fraser sockeye as a result of the 2009 season.
5. For planning fisheries, the Panel has adopted 50% probability level forecasts for Early Stuart (41,000 fish), Early Summer-run (783,000 fish), Summer-run (2,612,000 fish), and Late-run sockeye (8,003,000 fish). When sufficient information is available in-season, the Panel will update run size estimates of Fraser River sockeye salmon, as appropriate.

Regulations

- i) If the abundance of Early Summer-run sockeye salmon is tracking at approximately the 50% probability level (783,000 fish) and the abundance of Summer-run sockeye salmon is tracking at approximately the 50% probability level (2,612,000 fish) and the runs arrive at or near expected dates, low impact fisheries would be expected to commence during the last week of 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 2010 management season.

**APPENDIX E: GUIDELINES FOR PRE-SEASON FRASER SOCKEYE FISHING
PLANS TO ADDRESS LATE-RUN¹² CONCERNS (agreed June 10,
2010)**

The 2010 cycle is the dominant-line cycle for Adams River sockeye. Late-run sockeye have historically produced large returns on this cycle line relative to Summer-run sockeye, and Adams/Late Shuswap sockeye are the predominant Late-run stock-group. The total forecast for Late-run sockeye in 2010 (8,003,000 fish at the p50% level) is similar to the average (1980-2006) 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 and 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 2010 is expected to occur on September 6. Given this timing, the expected difference between estimates, and based on the p50 forecast level of abundance (8,003,000 fish), the exploitation rate limit is 46%.
2. The pre-season fishing plan assumes a 12 day separation in the 50% marine migration timing date (through Juan de Fuca Strait; Area 20) between Summer-run (August 3) and Late-run sockeye (August 15).
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% p 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 will be constrained by limits on Late-run sockeye harvest impacts. Late-run sockeye catches will be estimated primarily with DNA stock identification methods.

¹² Late-run here refers to the Late-run timing group, including Birkenhead sockeye and a few minor miscellaneous sockeye stocks.

APPENDIX F: 2010 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 1, 2010.

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 27th day of June, 2010, to the 11th day of September, 2010, 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 27th day of June, 2010, to the 11th day of September, 2010, 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 27th day of June, 2010 to the 2nd day of October, 2010, 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 27th day of June, 2010, to the 2nd day of October, 2010, 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 27th day of June, 2010, to the 16th day of October, 2010, both dates inclusive.
 - b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 29 from the 27th day of June, 2010, to the 16th day of October, 2010, 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 2010 season, the Fraser River Panel will adopt Orders establishing open fishing periods based on a 2010 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 27th day of June, 2010 to the 11th day of September, 2010, 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 27th day of June, 2010, to the 18th day of September, 2010, 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 19th day of September, 2010, to the 2nd day of October, 2010, both dates inclusive.

All-Citizen Fisheries:

1. No person shall fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 4B, 5, and 6C with nets from the 27th day of June, 2010, to the 11th day of September, 2010, both dates inclusive.
2. No person shall fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 6, 6A, 7 and 7A with nets from the 27th day of June, 2010, to the 18th day of September, 2010, both dates inclusive.
3. No person shall fish for sockeye or pink salmon with nets in that portion of Puget Sound Salmon Management and Catch Reporting Area 7A lying westerly of a straight line drawn from the low water range marker in Boundary Bay on the International Boundary through the east tip of Point Roberts in the State of Washington to the East Point Light on Saturna Island in the Province of British Columbia from the 19th day of September, 2010, to the 2nd day of October, 2010, both dates inclusive.

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

Treaty Indian and All-Citizen Fisheries:

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

During the 2010 season, the Fraser River Panel will adopt Orders establishing open fishing periods based on a 2010 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: 2010 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 in 2010.

July 27, 2010

United States

Treaty Indian

Areas 4B, 5 and 6C

Open to drift gillnets from 12:00 p.m. (noon), Thursday, July 29, 2010 to 12:00 p.m. (noon) Saturday, July 31, 2010.

July 30, 2010

United States

Treaty Indian

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon), Saturday, July 31, 2010, to 12:00 p.m. (noon) Wednesday, August 4, 2010.

August 3, 2010

United States

Treaty Indian

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon), Wednesday, August 4, 2010 to 12:00 p.m. (noon) Saturday, August 7, 2010.

Areas 6, 7 and 7A

Open to net fishing from 5:00 a.m. Friday, August 6, 2010 to 5:00 a.m. Sunday, August 8, 2010.

All Citizen

Areas 7 and 7A

Open to purse seines from 5:00 a.m. to 9:00 p.m., Sunday, August 8, 2010.

Areas 7 and 7A

Open to reefnets from 5:00 a.m. to 9:00 p.m., Sunday, August 8, 2010.

Areas 7 and 7A

Open to gillnets from 8:00 a.m. to 11:59 p.m. (midnight), Sunday, August 8, 2010.

August 6, 2010

Canada

Area 20-1, 3, 4

Open to Area B purse seine, ITQ Demonstration Fishery; daily from 6:00 a.m. to 9:00 p.m. Sunday, August 8, 2010 to Thursday August 12, 2010 (please refer to DFO Fishery Notices for further details).

Area 18-1, 18-4 and 18-11 and Areas 29 – 1 to 6

Open to Area H troll 12:01 a.m. Sunday, August 8, 2010, until further notice.

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

Open to Area E gillnets from 2 p.m. to 5:00 p.m., Tuesday, August 10, 2010. (Please refer to DFO Fishery Notices for further details).

United States

Treaty Indian

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon), Saturday, August 7, 2010 through 12:00 p.m. (noon) Tuesday, August 10, 2010.

August 15, 2010

Canada

Area 20-1, 3, 4

Open to Area B purse seine, ITQ Demonstration Fishery; daily from 6:00 a.m. to 9:00 p.m. Monday, August 16, 2010 through Thursday, August 19, 2010 (please refer to DFO Fishery Notices for further details).

United States

Treaty Indian

Areas 4B, 5 and 6C

Open for drift gillnets from 6:00 p.m. Sunday, August 15, 2010 through 12:00 p.m. (noon) Wednesday, August 18, 2010.

Areas 6, 7 and 7A

Open to net fishing from 5:00 a.m. through 9:00 p.m. Wednesday, August 18, 2010.

All Citizen

Areas 7 and 7A

Open to purse seines from 8:00 a.m. to 4:00 p.m., Tuesday, August 17, 2010.

Areas 7 and 7A

Open to reefnets from 8:00 a.m. to 4:00 p.m., Tuesday, August 17, 2010.

Areas 7 and 7A

Open to gillnets from 3:00 p.m. to 11:00 p.m., Tuesday, August 17, 2010.

August 17, 2010

Canada

Area 20-1, 3, 4

Open to Area B purse seine, ITQ Demonstration Fishery; from 6:00 a.m. to 9:00 p.m. Friday, August 20, 2010 (please refer to DFO Fishery Notices for further details).

Area 29: Portions of 29 -3, 4 and 6

Open to Area B purse seine from 6:00 a.m. to 9:00 p.m. Wednesday, August 18, 2010 (please refer to DFO Fishery Notices for further details).

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

Open to Area E gillnets from 10:00 a.m. to 3:00 p.m., Wednesday, August 18, 2010. (Please refer to DFO Fishery Notices for further details).

United States

Treaty Indian

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Wednesday, August 18, 2010 through 12:00 p.m. (noon) Friday, August 20, 2010.

Areas 6, 7 and 7A

Extended for net fishing from 9:00 p.m. Wednesday, August 18, 2010 through 9:00 a.m. Thursday, August 19, 2010.

August 20, 2010

Canada

Area 20-1, 3, 4

Open to Area B purse seine, ITQ Demonstration Fishery; daily from 6:00 a.m. to 9:00 p.m. Sunday, August 22, 2010 through Friday August 27, 2010 (please refer to DFO Fishery Notices for further details).

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

Open to Area E gillnets from 12 p.m. noon to 8:00 p.m., Monday, August 23, 2010 (please refer to DFO Fishery Notices for further details).

United States

Treaty Indian

Areas 4B, 5 and 6C

Open for drift gillnets from 3:00 p.m., Friday, August 20, 2010 through 12:00 p.m. (noon) Wednesday, August 25, 2010.

Areas 6, 7, and 7A

Open to net fishing from 5:00 a.m. Sunday, August 22, 2010 through 9:00 a.m. Wednesday, August 25, 2010.

All Citizen

Areas 7 and 7A

Open to purse seines from 11:00 a.m. through 5:00 p.m. Saturday, August 21, 2010, 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 from 5:00 a.m. to 9:00 p.m., Saturday, August 21, 2010.

Areas 7 and 7A

Open to gillnets from 8:00 a.m. to 12:00 a.m. (midnight), Saturday, August 21, 2010.

August 24, 2010

Canada

Area 29: Subareas 29-1 to 4, 6, 7 and 9 to 17

Open to Area E gillnets from 12:00 p.m. (noon) Wednesday, August 25, 2010 to 8:00 p.m., Thursday, August 26, 2010. (Please refer to DFO Fishery Notices for further details).

United States

Treaty Indian

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon), Wednesday, August 25, 2010 through 12:00 p.m. (noon) Saturday, August 28, 2010.

Areas 6, 7, and 7A

Open to net fishing from 5:00 a.m. Thursday, August 26, 2010 through 9:00 a.m. Sunday, August 29, 2010.

All Citizen

Areas 7 and 7A

Open to purse seines from 5:00 a.m. through 9:00 p.m. Wednesday, August 25, 2010.

Areas 7 and 7A

Open to reefnets from 5:00 a.m. to 9:00 p.m., Wednesday, August 25, 2010 and from 5:00 a.m. to 9:00 p.m., Thursday, August 26, 2010.

Areas 7 and 7A

Open to gillnets from 8:00 a.m. to 11:59 p.m. (midnight) Wednesday, August 25, 2010.

August 27, 2010

Canada

Area 29: Subareas 29-1 to 4, 6, 7 and 9 to 17

Open to Area E gillnets from 10:00 a.m. Monday, August 30, 2010 to 10:00 a.m., Tuesday, August 31, 2010; and open from 7:00 a.m. to 7:00 p.m. Wednesday, September 1, 2010 (Please refer to DFO Fishery Notices for further details).

United States

Treaty Indian

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Saturday, August 28, 2010 through 12:00 p.m. (noon) Wednesday, September 1, 2010.

Areas 6, 7 and 7A

Extended for net fishing from 9:00 a.m. Sunday, August 29, 2010, through 9:00 a.m. Monday, August 30, 2010. Open to net fishing from 5:00 a.m. Tuesday, August 31, 2010 through 9:00 a.m. Wednesday, September 1, 2010.

All Citizen

Areas 7 and 7A

Open to purse seines from 5:00 a.m. through 9:00 p.m., Monday, August 30, 2010.

Areas 7 and 7A

Open to reefnets from 5:00 a.m. to 9:00 p.m., Monday, August 30, 2010, and from 5:00 a.m. to 9:00 p.m., Tuesday, August 31, 2010.

Areas 7 and 7A

Open to gillnets from 8:00 a.m. to 11:59 p.m. (midnight), Monday, August 30, 2010.

August 31, 2010

Canada

Area 29: Subareas 29-1 to 4, 6, 7 and 9 to 17

Open to Area E gillnets from 7:00 a.m. to 7:00 p.m., Thursday September 2, 2010 (Please refer to DFO Fishery Notices for further details).

United States

Treaty Indian

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Wednesday, September 1, 2010 through 12:00 p.m. (noon) Saturday, September 4, 2010.

Areas 6, 7 and 7A

Extended for net fishing from 9:00 a.m. Wednesday, September 1, 2010, through 9:00 a.m. Friday, September 3, 2010.

All Citizen

Areas 7 and 7A

Open to purse seines from 9:00 a.m. through 9:00 p.m., Friday, September 3, 2010 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 from 5:00 a.m. to 9:00 p.m., Friday, September 3, 2010.

Areas 7 and 7A

Open to gillnets from 8:00 a.m. to 11:59 p.m. (midnight), Friday, September 3, 2010.

September 3, 2010

Canada

Area 29: Subareas 29-1 to 4, 6, 7 and 9 to 17

Open to Area E gillnets from 7 a.m. Monday, September 6, 2010 to 7:00 a.m., Tuesday, September 7, 2010 (Please refer to DFO Fishery Notices for further details).

United States

Treaty Indian

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Saturday, September 4, 2010 through 12:00 p.m. (noon) Wednesday, September 8, 2010.

Areas 6, 7 and 7A

Open for net fishing from 5:00 a.m. Saturday, September 4, 2010 through 9:00 a.m. Wednesday, September 8, 2010.

All Citizen

Areas 7 and 7A

Open to reefnets daily from 5:00 a.m. to 9:00 p.m., from Saturday, September 4, 2010 through Tuesday, September 7, 2010.

September 7, 2010

Canada

Area 29: Portions of Subareas 29-3, 4 and 6 (seaward of the 45 meter depth contour)

Open to Area B purse seine ITQ daily from 7:00 a.m. to 7:00 p.m. on Thursday, September 9, 2010 and Friday September 10, 2010.

United States

Treaty Indian

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Wednesday, September 8, 2010 through 11:59 p.m. (midnight), Saturday, September 11, 2010.

Areas 6, 7 and 7A

Open for net fishing from 5:00 a.m. Thursday, September 9, 2010 through 9:00 a.m. Saturday, September 11, 2010.

All Citizen

Areas 7 and 7A

Open to purse seines from 5:00 a.m. through 9:00 p.m., Wednesday, September 8, 2010.

Areas 7 and 7A

Open to reefnets daily from 5:00 a.m. to 9:00 p.m., from Wednesday, September 8, 2010 through Friday, September 10, 2010.

Areas 7 and 7A

Open to gillnets from 8:15 a.m. to 11:59 p.m. (midnight), Wednesday, September 8, 2010.

September 10, 2010

Canada

Area 29: Portions of Subareas 29-3, 4 and 6 (seaward of the 45 meter depth contour)

Open to Area B purse seine ITQ daily from 7:00 a.m. to 7:00 p.m. from Saturday, September 11, 2010 through Monday, September 13, 2010.

United States

Treaty Indian

Areas 6, 7 and 7A

Extended for net fishing from 9:00 a.m. Saturday, September 11, 2010 through 9:00 a.m. Tuesday, September 14, 2010.

All Citizen

Areas 7 and 7A

Open to reefnets daily from 5:00 a.m. to 9:00 p.m., from Saturday, September 11, 2010 through Friday, September 17, 2010

September 14, 2010

United States

Treaty Indian

Areas 6, 7 and 7A

Open for net fishing from 5:00 a.m. Thursday, September 16, 2010 through 11:59 p.m. (midnight) Saturday, September 18, 2010.

All Citizen

Areas 7 and 7A

Open to reefnets from 5:00 a.m. to 9:00 p.m. Saturday, September 18, 2010.

September 17, 2010

Canada

Area 18-1, 18-4 and 18-11 and Areas 29 – 1 to 6

Area H troll closes at 11:59 p.m. (midnight) Saturday, September 18, 2010.

Fraser River Panel control of Panel Areas was relinquished in accordance with the pre-season Regulations (Appendix F) as follows:

- Canada: Area 20 on September 11; Areas 17 and 18 on October 2; and Area 29 on October 16;
- United States: Areas 4B, 5 and 6C on September 11; Areas 6, 7 and 7A on September 18; and the remaining portions of Area 7A on October 2.

APPENDIX H: PSC STOCK MONITORING, IDENTIFICATION, ASSESSMENT AND MANAGEMENT ADJUSTMENT PROGRAMS

Stock Monitoring

The goals of the stock monitoring program are to monitor and assess the abundance and migration timing of Fraser River sockeye and, in odd years, 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 to support these objectives. In addition to providing estimates of daily abundance through marine areas and past Mission, stock monitoring analyses project the number of fish migrating between marine areas and Mission, and provide in-season estimates of the proportion of fish migrating via Johnstone Strait (i.e., diversion rates). This information is required for the development of fishing plans that aid in meeting spawning escapement and catch allocation objectives.

The migrations of Fraser sockeye and pink salmon through marine areas are tracked primarily through test fisheries and to a lesser extent commercial and First Nations fisheries in marine areas, beginning in Juan de Fuca and Johnstone Straits and extending to the mouth of the Fraser River. Information about upstream migration in the Fraser River is obtained from the hydroacoustic program at Mission, lower river gillnet test fisheries, visual observations at Hells Gate and analysis of catches in Fraser River commercial and First Nations fisheries. Between June 21-October 3, estimates of Mission sockeye escapements by stock group were derived by applying species composition data to the hydroacoustic estimates. Upstream passage was monitored using the Whonnock (Area 29-16) test fishery on October 4-6. Daily observations at Hells Gate between July 2-October 8 provided qualitative information on the success of upstream fish passage and abundance.

A. Test Fishing

Commercial fisheries historically provided much of the data used to assess abundance and migration timing. Limited commercial fishing in recent years, however, has reduced the availability of this information. Test fisheries conducted by the Commission therefore provide important data throughout the fishing season. Test fisheries provide abundance-related data such as catch and 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 describes when test fisheries were conducted, Table H1 below summarizes more detailed information about the type of nets and sampling strategies used.

Information about the migration of 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 (Johnstone Strait), but is augmented during the early part of the season by test fisheries in U.S. Areas 5 (Juan de Fuca Strait) and 7 (San Juan Islands) (Figure 1 in main body of report). Test fisheries in the Fraser River (Area 29) are used to assess species and stock composition for application to Mission passage estimates. These test fisheries also provide abundance estimates through the use of CPUE models when the Mission hydroacoustic program is inactive or when the presence of pink salmon confounds the estimation of hydroacoustic-based sockeye passage at Mission.

In 2010, catches in the Area 20 gillnet test fishery began to build in July. Around the middle of July, CPUE values in this fishery began to exceed both the all-years' historic average and the 2010 cycle year average. Test fishing catches remained intermittently very strong through to August 15, and were the first signal of the very large sockeye run to come. Sockeye catches in the Area 20 purse seine test fishery in 2010 were relatively large in a historical context, despite the high diversion rate through Johnstone Strait. The largest daily catch in 2010 of 11,556 sockeye in 5 sets (2,311 sockeye/set) occurred on August 12, and a new record for the largest catch in a single Area 20 purse seine set (9,305 sockeye) was established on August 18. Relatively weak catches in

the Round Island (Area 12) gillnet test fishery at the start of the season were indicative of the initial low diversion through Johnstone Strait. Catches in this test fishery increased substantially around August 10, partly due to a swing in the predominant migration route (i.e., diversion rate) from the Juan de Fuca Strait to the Johnstone Strait route. Similarly, catches in the Area 12 purse seine test fishery followed historic cycle year averages until the middle of August, after which they increased to record high values (16,273 sockeye/set on August 26). Catches in the Area 13 purse seine test fishery were considerably lower but peaked at 6,816 sockeye/set on August 28.

In the Fraser River, sockeye test fishery catches at both Cottonwood and Whonnock were modest (20-30 sockeye/set on most days) and similar to past years' catches on this cycle. Peak catches at these sites lined up relatively well with each other and with peak escapements at Mission. In 2010, the PSC continued to use an electric deterrent system designed to reduce the rate that seals remove salmon from the Cottonwood test fishery gillnet. Such removal rates were generally reported as lower than in previous years.

Table H1. Sampling details for Panel-approved test fisheries conducted in 2010.

Area	Name	Gear	Number of Vessels	Net Length (m)	Net Depth (meshes)	Mesh Size (mm) (in)	Number of Sets	Set Duration (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
29-14	Fraser R. (Cottonwood)	Gillnet	1	292	Variable	Variable	1	30
29-16	Fraser R. (Whonnock)	Gillnet	1	319	Variable	Variable	2	20
United States Panel Areas								
5	Juan de Fuca Str.	Gillnet	1	803	220	130 5 1/8	2	400
7	San Juan Islands	Reefnet ¹	3	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	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	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 used a 90 Mesh Alaska twist net.							

B. Mission Hydroacoustics

PSC staff have operated a hydroacoustic facility on the Fraser River near the Mission Bridge since 1977 to provide 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^{13,14}. Daily abundance at Mission is estimated using a split-beam hydroacoustic system on the south shore (i.e., “left bank” when looking downstream) of the Fraser River, combined with a split-beam system mounted on a vessel that runs back and forth across the river. Both of these systems operate 24-hrs a day and provide information about target density, fish behaviour, vessel speed and transducer placement. Additional work in 2010 focused on gathering independent

¹³ 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.

¹⁴ 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.

diagnostic information (e.g., using a “dual frequency identification sonar” or DIDSON) to verify assumptions used in the estimation procedure.

Daily estimates of fish abundance past Mission are produced by combining estimates from the shore-based and vessel-based sonar systems. The shore-based 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 the water column to be sampled by the narrow sonar beams at multiple aiming angles. The aim and orientation of the transducers were monitored and verified with an attitude sensor. A near-shore 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 the fish were insonified. This ensured adequate numbers of echoes for tracking individual fish, particularly for sockeye salmon that migrated close to shore. Transducer aims were optimized to reduce non-sampled areas where migratory abundance must be estimated by extrapolation. The vessel-based system consisted of a downward-looking split-beam circular transducer (15°) that transected the river every five minutes to obtain target density information.

Traces of individual fish as they passed through the sound-beams were acquired by analyzing the echo data from both shore and vessel-based systems using an alpha-beta tracker^{15,16}. The resulting trace data (i.e., “tracks”) were then classified as fish or noise (e.g., debris, air bubbles) using statistical methods¹⁷ (i.e., “discriminate function analysis” or DFA). The integrity of the tracks were verified by trained staff, and unusual or atypical targets were identified and removed using a graphical user interface (GUI) software. This data processing procedure was performed each day for the data collected from both the shore and vessel-based split-beam systems. The final fish track data were analyzed to produce statistics and daily summaries. Daily estimates of fish abundance were obtained from a flux estimation software program (Flux Estimator v1.0) that used the processed shore and vessel-based data to calculate daily fish passage past Mission. The resulting total salmon estimates were further apportioned into various salmon species and stocks based on daily in-river test fishery catches in the lower river at Whonnock and Cottonwood. The Mission hydroacoustic program produced daily Mission escapement estimates from July 6 to October 3 in 2010.

This was the third 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. Regular information exchanges occurred three times each week. This in-season data exchange allowed PSC staff to monitor any divergence in estimates between the two sites and to revise in-season estimates of daily Mission escapement accordingly.

In addition to the split-beam based estimation program at Mission, several experiments were conducted in 2010 using three DIDSON units and a mid-channel split-beam system. These experiments and their main objectives are detailed below.

i. DIDSON counting of near-shore fish passage

An important application of DIDSON technology in the 2010 field season was to estimate fish passage in near-shore areas of both the left and right river banks at Mission. To achieve this purpose a standard DIDSON unit was deployed on the left bank from July 7-October 3 and a long range DIDSON unit was deployed on the right bank from July 15-September 13 (Figure H1). The long range DIDSON on the right bank was attached to a rotator to control its tilt so as to sample the water column at two pitch angles. Both systems recorded daily fish passage data up to 20 m off both shores using systematic sampling schemes. The DIDSON technology proved to be much more robust than the conventional split-beam sonar technology in enumerating sockeye salmon

¹⁵ Blackman, S. S. and R. Popoli. Design and Analysis of Modern Tracking Systems. Artech House, Boston, 1999.

¹⁶ 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.

¹⁷ McLachlan, G. J. (1992). Discriminant Analysis and Statistical Pattern Recognition. Wiley, New York.

passage in September, when extremely high passage occurred close to the bottom and in near-shore waters. We developed a calculation procedure to include the left and right bank DIDSON counts in an estimation model. These estimates were reviewed post-season.

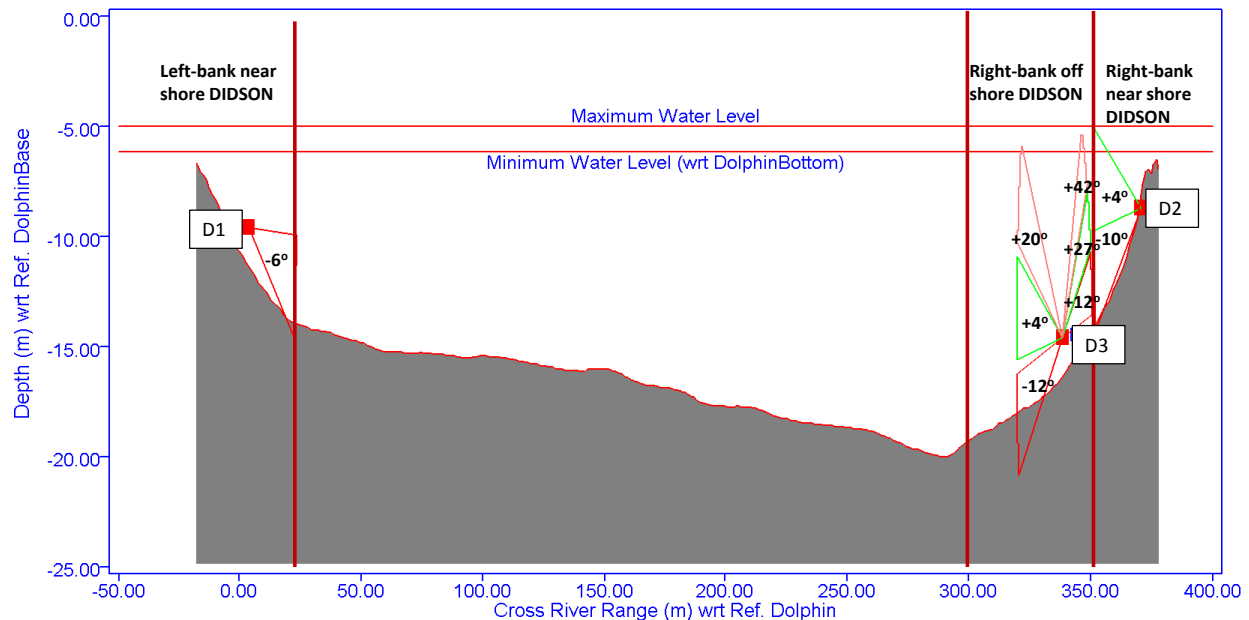


Figure H1. Deployment locations and sampling areas for the three DIDSON units in 2010.

ii. DIDSON counting of off-shore fish passage

Another application of DIDSON in 2010 was to estimate fish passage in the off-shore area from the right bank at Mission. The objective of this trial was to verify estimates of fish passage from the current mobile downward-looking split-beam system off the right shore during periods of heavy migration. A standard DIDSON unit was deployed on a tripod anchored on the river bottom 50 m offshore of the right bank between August 26 – October 3 (Figure H2). The unit was attached to a rotator to control the pan and tilt of the DIDSON, thereby allowing sampling of the water column in both near shore and offshore directions at six aiming angles. This system collected daily fish passage data up to 20 m in range for each of the 6 aims using a systematic sampling scheme. A calculation procedure that incorporated these off-shore fish passage data into the current estimation model was developed. The extent of estimation differences when the off-shore DIDSON data was used was assessed post-season.

iii. Mid-channel sampling experiment under SEF

As a continuation of Phase 1 of a Southern Boundary Restoration and Enhancement Fund (SEF) project conducted in 2008-09, Phase 2 of a mid-channel sampling experiment was conducted in September of 2010 near the Mission site. The purpose of the study was to improve the accuracy and precision of daily salmon estimation in the offshore area¹⁸. A fishing vessel was chartered for 15 days. A 6-degree split-beam transducer with a dual axis rotator was deployed off the stern of the vessel to sample the water column on both sides of the vessel. An hourly sampling scheme was used that partitioned the transducer's sound-beam at 6 pitch angles to sample a local cross-section of the river up to 40 m from the location of the anchored vessel. A Biosonics DTX-4 206KHz digital split-beam echosounder was used for data acquisition. A standard DIDSON was also deployed off the stern of the vessel for the entire duration of the experiment to concurrently

¹⁸ 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.

record fish passage data for cross-comparisons with the data acquired by the DTX-4 split-beam system. The sampling geometry of the split-beam transducer is shown in Figure H2.

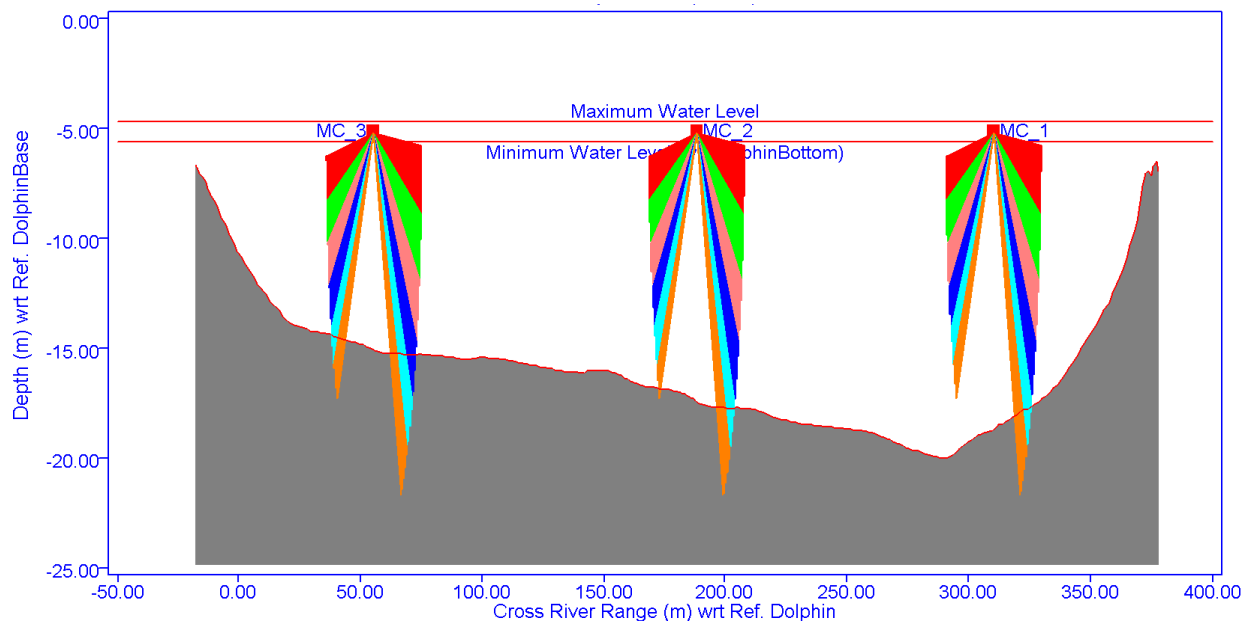


Figure H2. Deployment locations and sampling areas for the mid-channel split-beam transducer in 2010.

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 River watershed. Stock identification data are also used to account for Fraser River 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 in 2010 used DNA¹⁹ and scale pattern analyses²⁰ of samples taken from fish caught in marine and in-river fisheries. In addition, hatchery-reared Cultus Lake juveniles have their adipose fins clipped prior to release, and absence of adipose fins allowed enhanced detection and targeted sampling of this stock in large commercial catches. Fraser River pink salmon do not return in appreciable numbers in even years so this report includes no assessment of them.

Each year the PSC scale lab digitizes salmon scales to acquire measurements that can be used for scale pattern analysis (i.e., stock identification), and interprets the annuli on salmon scales and otoliths to determine their age (e.g., 4₂, 5₂). While DNA is relied upon heavily for stock discrimination, digitized scale measurements are important because they are used for scale pattern analyses (i.e., stock identification) to augment the DNA-based analyses. Scale pattern analysis is relied on for analyzing samples during periods and for locations in which there are few stocks in mixed-stock samples and the stock composition of the samples can more easily and cheaply be resolved using scale data than DNA data. This allows the limited DNA budget to be focused on stock identification problems that are most challenging. Age data remains fundamental to in-

¹⁹ 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.

²⁰ Gable, J. and S. Cox-Rogers. Stock identification of Fraser River sockeye salmon: methodology and management application. PSC Tech. Rep. No. 5, October, 1993.

season interpretations of relative stock strength and to post-season assignment of total returns by age and by stock, which is important for producing spawner-recruit datasets used to forecast returns in future years. During the 2010 in-season period the lab aged approximately 24,200 scales of which 23,600 were digitized. Following the season an additional 7,500 scales were digitized and 7,500 otoliths were read for age determination from spawning ground collections.

Analyses of samples from catches in test fisheries were conducted daily, beginning in late June and continuing through late September. Commission staff sampled sockeye in test and commercial fishery catches, and a limited number from sport and Food, Social and Ceremonial fishery catches. Sampling locations included Port Renfrew, Nanaimo and Vancouver in British Columbia, and Bellingham and Sekiu in Washington. The Alaska Department of Fish and Game (ADF&G) collected samples for the PSC from District 104 purse seine landings in Ketchikan, Craig and Petersburg. Langara Fishing Adventures provided samples from recreational catches near Haida Gwaii (formerly called the Queen Charlotte Islands). DFO provided samples from Johnstone Strait test fisheries and a commercial landing in Port Hardy. Commission staff and DFO sampled Economic Opportunity fisheries in the Fraser River. In addition, DFO and First Nations personnel obtained samples from a variety of Fraser River First Nations and sport catches when these were available.

In-season commercial samples of sockeye, with the exception of those collected in District 104, were more numerous than in any recent year. Overall, commercial catches accounted for approximately 30% of all samples analyzed for stock composition. Large sample sizes were available from most fisheries in Panel Areas. Test fisheries accounted for about 60% of the samples analyzed, while First Nations, sport and research samples made up the remainder. The DNA lab at DFO's Pacific Biological Station processed over 19,000 multi-locus genotypes in 2010.

Fraser River sockeye comprised approximately 94% age 4₂ sockeye (nearly 90% of which were from Shuswap and Chilko lakes) and 4% age 4₁ sockeye from the Harrison River (not lake rearing). The remaining 2% was composed of three- and five-year-olds. In most years the age 5₂ category is the second most numerous age class of Fraser River sockeye. In 2010, age 5₂ sockeye were less numerous than both 4₁ and 3₁ sockeye, and in only two major stocks did the proportion of age 5₂ sockeye exceed 10% (Pitt - 34%; Birkenhead - 16%). The two stocks most responsible for the lower-than-expected return of age 4₂ sockeye in 2009, Chilko and Quesnel lakes, displayed a continued weakness of this cohort in 2010 (age 5₂ sockeye made up less than 1% of returning Chilko and Quesnel sockeye). Almost all of the three-year-old sockeye were age 3₁ sockeye from the Harrison River. The often strong return of Harrison River 'sea-type' sockeye in recent years is a phenomenon that has garnered attention. These fish have a protracted return migration and, relative to other Fraser River sockeye, seem to prefer the southern route around Vancouver Island. They can therefore be the predominant stock in samples from Juan de Fuca Strait for a large portion of the season.

Proportions of Fraser River sockeye caught in District 104 purse seine fisheries were estimated by scale and DNA analyses in 2010. At 18,600, the sockeye catch in District 104 was considerably lower than in other recent years. Post-season estimates of the Fraser River sockeye catch in District 104 are in the 0-50 range.

Stock Assessment

Assessment of Fraser River sockeye abundance by stock group is primarily based on catch, effort, escapement and stock composition data. Even though commercial catches totalled more than 12 million salmon in 2010, stock assessment methods relied mainly on catch and CPUE data from test fishing vessels to assess abundance by stock group. These data are analysed using Bayesian stock assessment models^{21, 22} that compare the reconstructed daily migration pattern to

²¹ 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.

²² 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.

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. Before the peak of the run is observed, timing and abundance are confounded. Thus a pattern of larger than expected daily abundances could be the result of the run being either larger or earlier than forecast. Alternatively, a pattern of smaller than expected abundances could be due to the run being either smaller or later than forecast. These scenarios cannot be distinguished prior to observing the peak of the run in the assessments.

Uncertainty about the actual run size is estimated by using the Bayesian methodology. The Bayesian stock assessment model relies on additional information to reduce the uncertainty and constrain run-size estimates within realistic bounds. Such additional information includes pre-season forecasts of run size based on historic stock-recruit data, timing forecasts based on sea-surface temperatures (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 data. 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. The Bayesian stock assessment model should theoretically 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 and d provide an overview of run-size estimates from the stock assessment models at various dates during the season (median and 80% probability interval). These estimates can be compared against the in-season run-size estimates officially adopted by the Panel and used for management purposes and against the final in-season run-size estimates (i.e., accounted catch + Mission escapement). For all management groups, run sizes were larger and migration timing was later than forecast, hence the gradual increases of run size estimates as the season progressed.

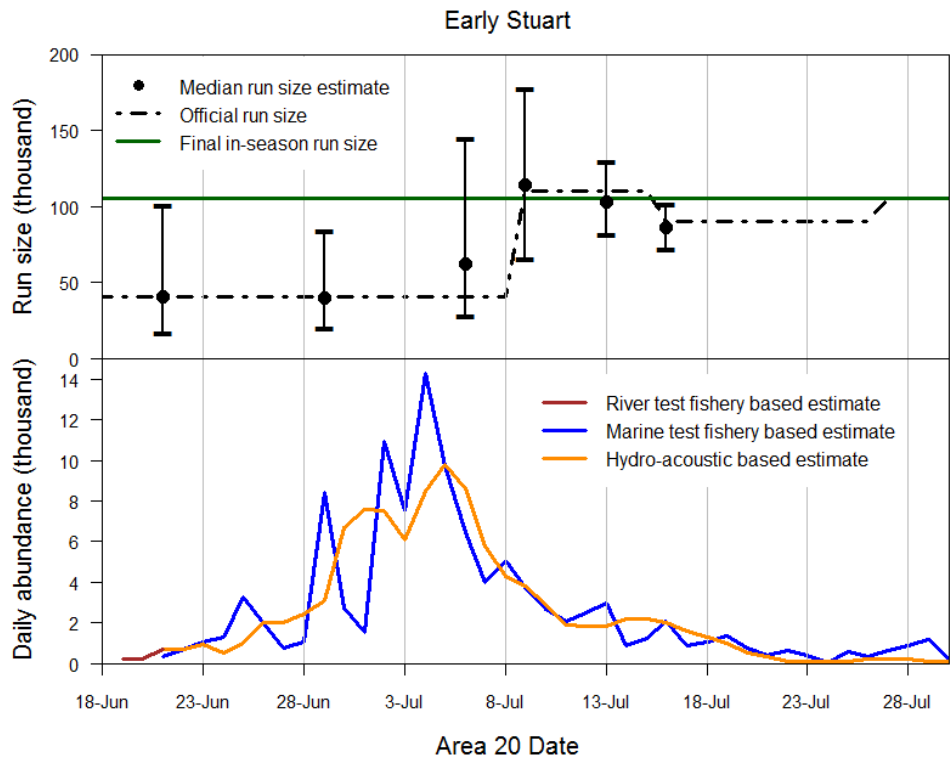


Figure H3a: Daily reconstructed abundance estimates for Early Stuart sockeye and corresponding run-size estimates at different times during the season.

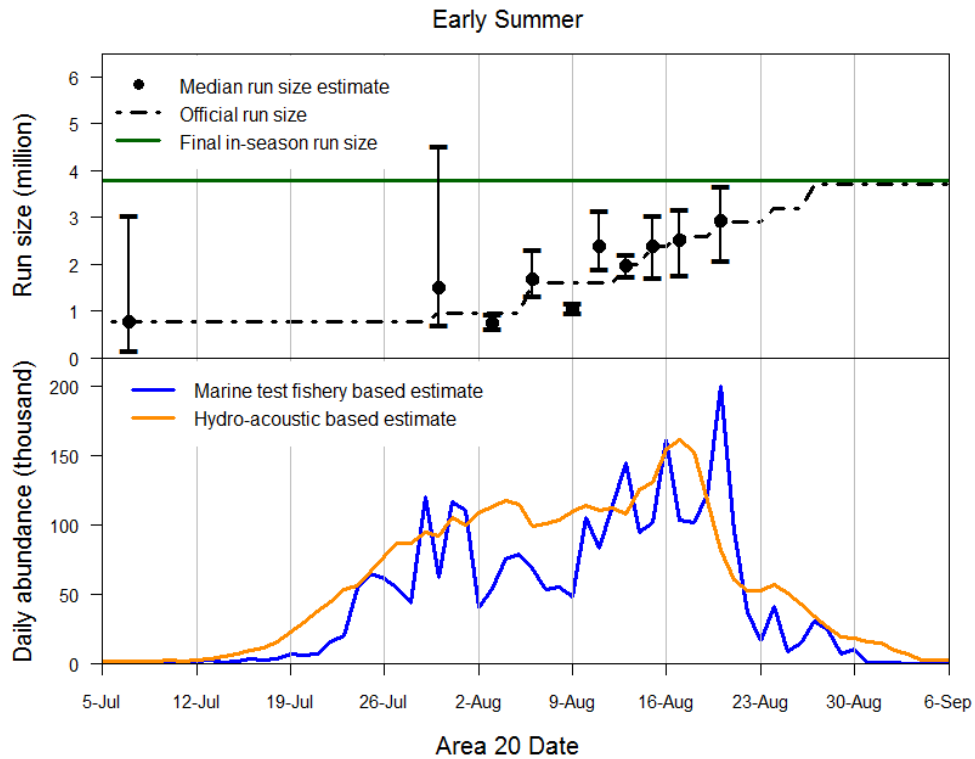


Figure H3b: Daily reconstructed abundance estimates for Early Summer-run sockeye and corresponding run-size estimates at different times during the season.

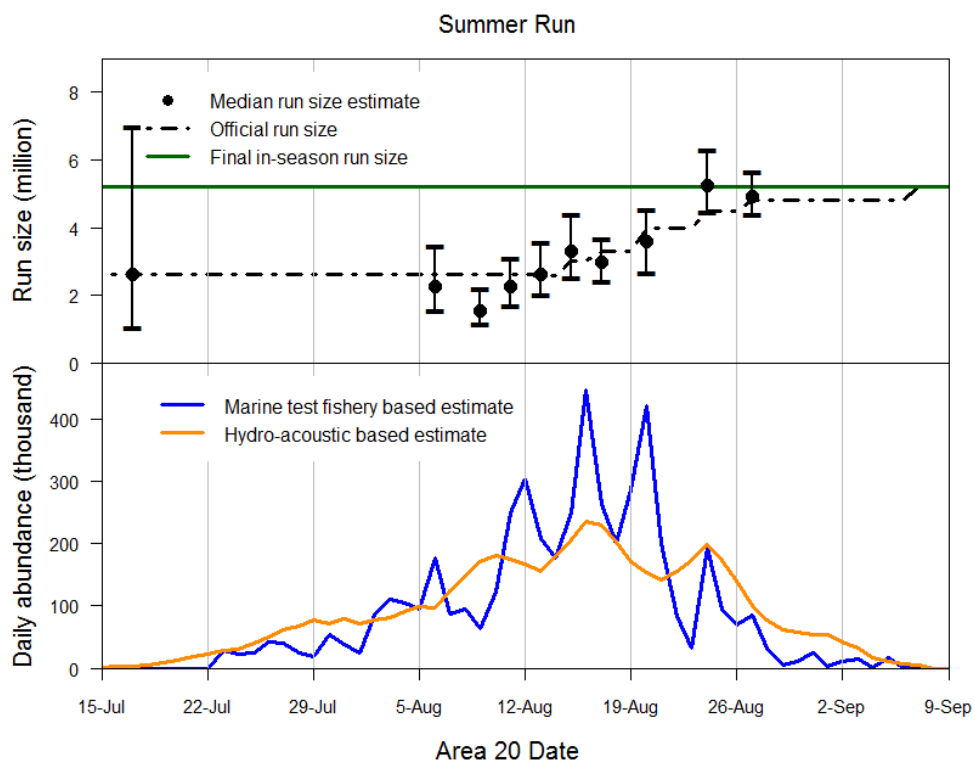


Figure H3c: Daily reconstructed abundance estimates for Summer-run sockeye and corresponding run-size estimates at different times during the season.

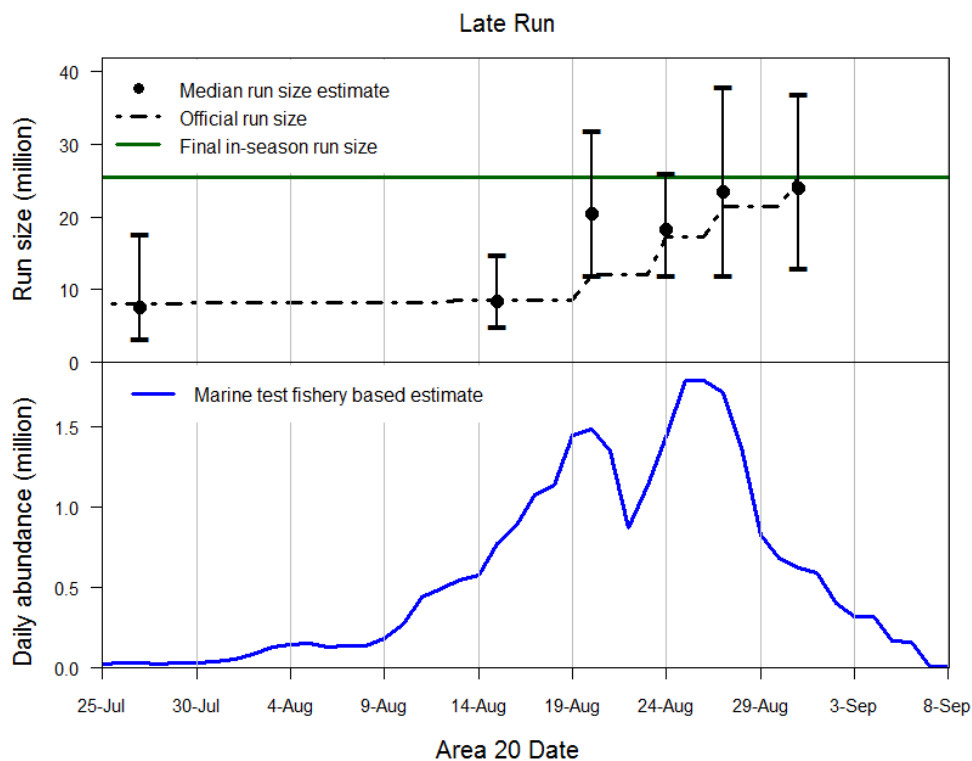


Figure H3d: Daily reconstructed abundance estimates for Late-run sockeye and corresponding run-size estimates at different times during the season.

Management Adjustment

MA assessments are derived from historical relationships between the ‘Difference Between Estimates’ (DBE) values and Fraser River discharge and water temperature. Historic DBEs are calculated using the difference between post-season estimates of potential spawning escapement (Mission escapement minus catch above Mission) and observed spawner abundances. In-season, predicted DBEs for Early Stuart, Early Summer and Summer stocks are based on the 19-day average of in-season estimates of discharge and temperature during the migration of each stock group and the historic relationship between discharge, temperature and DBE. In-season estimates of discharge and temperature are provided by the Environmental Watch Program (EWP) and include up to 10 days of forecasted Fraser River discharge and water temperature data in combination with at least 9 days of observed data, as measured near Hope.

MA assessments in 2010 were performed using a Bayesian regression model. Such Bayesian regressions result in a family of regression lines that provide a distribution of DBE predictions for a given set of temperature and discharge values, each one with an associated probability of being true. Uncertainty is therefore incorporated in the DBE and MA predictions.

APPENDIX I: HISTORICAL CATCH, ESCAPEMENT AND PRODUCTION DATA, AND DETAILED 2010 TAC CALCULATION

Table I1. Catch by user group, spawning escapement, Run-size Adjustment (RSA) and abundance of Fraser River sockeye salmon for cycle years 1998-2010.

	Fraser Sockeye Salmon			
	1998	2002	2006	2010
CANADIAN CATCH	2,239,000	3,617,400	4,571,500	11,569,200
Commercial Catch	1,278,000	2,218,400	3,247,000	9,243,700
Panel Area	283,000	1,352,100	921,000	3,459,100
Non-Panel Areas	995,000	866,200	2,326,000	5,784,600
First Nations Catch	844,000	1,155,000	1,146,000	2,015,100
Marine FSC	200,000	265,000	298,000	308,500
Fraser River FSC	644,000	770,000	393,000	570,100
Economic Opportunity	0	120,000	455,000	1,136,500
Non-commercial Catch	117,000	244,000	178,500	310,400
Marine Recreational	0	5,000	37,000	80,500
Fraser Recreational	18,000	123,000	134,000	212,800
Charter	0	7,000	600	6,600
ESSR	99,000	109,000	6,900	10,500
UNITED STATES CATCH	708,000	450,000	727,500	1,959,500
Washington Total	522,000	449,000	707,500	1,959,500
Commercial catch	522,000	434,000	703,000	1,945,100
Treaty Indian	293,000	298,000	487,000	1,202,600
Non-Indian	229,000	136,000	216,000	742,500
Non-commercial Catch	0	15,000	4,500	14,400
Ceremonial	0	15,000	4,500	14,400
Recreational	0	0	0	0
Alaska	186,000	1,000	20,000	0
TEST FISHING CATCH	107,000	156,000	140,400	71,900
PSC (Panel Areas)	74,000	141,000	72,400	27,000
Canada	74,000	141,000	63,000	17,800
United States	0	0	9,400	9,200
Canada (non-Panel Areas)	33,000	15,000	68,000	44,900
TOTAL RUN	10,875,700	15,062,400	12,981,500	28,264,700
Total Catch in All Fisheries	3,054,000	4,223,400	5,439,400	13,600,600
Adult Spawning Escapement	4,422,100	10,125,600	4,661,500	13,130,900
Jack Spawning Escapement	5,600	5,400	1,700	12,100
Preliminary Run-size Adjustment	3,394,000	708,000	2,879,000	1,521,100

Table I2. Catch of Fraser River sockeye salmon in Canadian First Nations fisheries (includes FSC, EO and Demo catches) by area for cycle years 1998-2010.*

Fishing Area	1998	2002	2006	2010
Fraser River	643,600	870,700	847,800	1,706,600
Fraser River Mainstem	594,800	841,600	770,700	1,374,800
Below Port Mann	101,300	129,600	158,300	369,100
Port Mann to Mission	77,300	118,500	120,400	264,200
Mission to Hope	88,100	147,100	169,400	308,600
Hope to Sawmill Cr.	187,900	261,200	183,600	269,000
Sawmill Cr. to Kelly Cr.	126,700	164,200	129,200	150,600
Kelly Creek to Prince George	8,100	11,700	4,700	7,100
Above Prince George	5,400	9,300	5,100	6,200
Tributaries	48,800	29,100	77,000	331,800
Harrison/Lillooet System	n/a	n/a	n/a	11,559
Thompson System	4,400	9,400	56,500	266,400
Chilcotin System	36,300	13,200	13,700	45,400
Nechako System	3,400	100	5,300	5,000
Stuart System	4,700	6,400	1,600	3,600
Marine Areas	200,000	264,700	297,700	308,500

* Data supplied by DFO.

Table I3. Escapement of sockeye salmon to Fraser River spawning areas for cycle years 1998-2010.

DISTRICT	Year			
<u>Stock Group</u>				
Stream/Lake	1998	2002	2006	2010
NORTHEAST				
Upper Bowron R.	4,751	8,770	1,554	8,983
STUART				
<u>Early Stuart</u>				
Driftwood R.	11,404	5,218	7,230	25,783
Takla L. Streams	12,284	10,007	10,261	11,061
Middle R. Streams	5,822	5,683	11,576	16,971
Trembleur L. Streams	2,947	3,492	6,671	6,447
<u>Late Stuart</u>				
Kazchek Cr.	2,228	760	104	32
Kuzkwa Cr.	2,864	2,810	3,139	3,610
Middle R.	38,906	7,452	7,513	13,340
Tachie R.	92,963	19,608	14,178	57,887
Miscellaneous	1,436	3,868	2,570	372
NECHAKO				
Nadina R. (Late)	756	421	4,144	4,783
Nadina Channel	2,949	1,504	4,511	21,359
Stellako R.	185,641	322,711	147,189	202,783
QUESNEL				
Horsefly R.	748,234	1,963,020	110,388	128,121
Horsefly Channel	24,934	0	19,599	22,493
McKinley Cr.	75,829	0	3,007	1,534
Mitchell R.	310,329	1,022,192	22,446	75,029
Miscellaneous	19,926	0	14,328	21,854
CHILCOTIN				
Chilko R. & L.	879,010	382,753	468,947	2,459,946
Chilko Channel	0	0	0	0
Taseko L.	485	1,300	2,140	1,117
SETON-ANDERSON				
Gates Cr.	936	222	0	6,280
Gates Channel	6,312	1,951	2,858	9,486
Portage Cr.	25,179	14,953	18,882	57,870
NORTH THOMPSON				
North Thompson R.	0	5,866	25,488	8,044
Raft R.	7,198	18,369	6,111	5,119
Fennell Cr.	8,750	7,331	11,482	10,808
SOUTH THOMPSON				
<u>Early Summer-run</u>				
Scotch Cr.	35,981	101,269	144,199	522,367
Seymour R.	34,048	113,408	107,941	552,149
Upper Adams / Momich / Cayenne	506	1,234	370	3,101
Miscellaneous	38,041	94,461	39,717	351,176
<u>Late-run</u>				
Adams R.	870,919	3,760,540	1,461,673	3,867,225
Little R.	176,205	678,652	416,790	422,358
Lower Shuswap R.	306,893	886,719	901,059	2,897,006
Miscellaneous	35,254	206,352	118,187	332,429
HARRISON-LILLOOET				
Birkenhead R.	295,669	189,446	266,459	128,285
Big Silver Cr. & misc. Birk. types	6,808	31,890	23,076	12,578
Harrison R.	4,496	41,542	168,259	761,668
Weaver Cr.	28,020	66,327	6,967	23,833
Weaver Channel	29,071	34,706	32,814	36,064
LOWER FRASER				
Nahatlatch R. & L.	7,993	7,305	1,678	5,413
Cultus L.	1,959	4,873	3,785	10,026
Upper Pitt R.	76,888	90,280	38,816	16,818
Chilliwack L./Dolly Varden Cr.	1,068	3,841	1,097	2,775
MISCELLANEOUS	183	2,470	2,256	4,482
ADULTS	4,422,075	10,125,576	4,661,459	13,130,865
JACKS	5,604	5,449	1,674	12,056
TOTAL NET ESCAPEMENT	4,427,679	10,131,025	4,663,133	13,142,921

* Estimates are from DFO.

1 Spawning ground estimates of escapement to Horsefly River and McKinley Creek were unavailable in 2002. Escapement was therefore indirectly estimated by applying the ratio of Mitchell River versus other Quesnel stocks at Mission to the enumerated spawning escapement to Mitchell River.

Spawning ground estimates of escapement to Birkenhead River were unavailable in 2002. The spawning escapement estimate was based on the estimated Mission escapement minus catch above Mission.

2 Cultus estimates include 276 fish in 2006 and 357 fish (342 adults + 15 jacks) in 2010 removed for broodstock.

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

Table I4. Detailed calculation of the achievement of the Total Allowable Catch (TAC) of Fraser River sockeye salmon by management group in 2010. 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 2), in accordance with Annex IV of the Treaty and the February 11, 2010 Commission Guidance.

TAC Calculations	Fraser Sockeye				Total
	Early Stuart	Early Summer	Summer	Late	
RUN STATUS, ESCAPEMENT NEEDS & AVAILABLE SURPLUS					
In-season Abundance Estimate	105,000	3,800,000	5,200,000	25,441,000	34,546,000
Adjusted Spawning Escapement Target *	105,000	2,067,200	2,392,000	13,738,100	18,302,300
Spawning Escapement Target (SET)	105,000	1,520,000	2,080,000	10,176,400	13,881,400
%SET from TAM rules	100%	40%	40%	40%	
Management Adjustment (MA)	8,400	547,200	312,000	3,561,700	4,429,300
Proportional MA (pMA)	0.08	0.36	0.15	0.35	
Test Fishing Catch (TF, post-seas. est.)	2,400	21,700	18,400	29,500	71,900
Surplus above Adjusted SET & TF	0	1,711,100	2,789,600	11,673,400	16,174,100
DEDUCTIONS & TAC FOR INTERNATIONAL SHARING					
Aboriginal Fishery Exemption (AFE) **	2,800	41,700	229,200	126,200	400,000
Total Deductions (Adj.SET + TF + AFE)	110,200	2,130,600	2,639,600	13,893,800	18,774,300
Available TAC (Abundance - Deductions)	0	1,669,400	2,560,400	11,547,200	15,776,900
UNITED STATES (Washington) TAC					
TAC - Payback	0	275,000	421,800	1,902,100	2,598,900
Proportionally distributed TAC ***	0	275,400	422,500	1,905,300	2,603,200
Propor. distrib. U.S. Payback	0	-500	-700	-3,100	-4,300
Washington Catch	300	226,700	386,300	1,346,300	1,959,500
Deviation	-300	48,300	35,400	555,900	639,400
CANADIAN TAC					
Balance to Canada + Payback + AFE	2,800	1,436,100	2,367,800	9,771,200	13,578,000
Propor. distrib. Balance + Payback	0	1,394,400	2,138,600	9,645,000	13,178,000
Aboriginal Fishery Exemption	2,800	41,700	229,200	126,200	400,000
Canadian Catch excluding ESSR Catch	3,500	993,800	1,965,900	8,595,500	11,558,700
Deviation	-700	442,300	402,000	1,175,700	2,019,300
TOTAL					
Available TAC + AFE	2,800	1,711,100	2,789,600	11,673,400	16,176,900
Total U.S. + Canadian Catch	3,800	1,220,500	2,352,200	9,941,800	13,518,200
Deviation	-1,000	490,600	437,400	1,731,600	2,658,700

* 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 Feb. 11, 2010, Commission Guidance.

APPENDIX J: MEMBERS OF THE FRASER RIVER TECHNICAL COMMITTEE IN 2010

United States	Canada
G. Graves, Co-Chair <i>Northwest Indian Fisheries Commission</i>	A. Huang, Co-Chair <i>Fisheries and Oceans Canada</i>
P. Busby <i>National Marine Fisheries Service</i>	S. Grant <i>Fisheries and Oceans Canada</i>
	D. McHugh <i>Fisheries and Oceans Canada</i>
	M. Mortimer <i>Fisheries and Oceans Canada</i>
	J. Scroggie <i>Fisheries and Oceans Canada</i>
	M. Staley <i>First Nations Advisor</i>

APPENDIX K: STAFF OF THE PACIFIC SALMON COMMISSION IN 2010

EXECUTIVE OFFICE

Don Kowal, Executive Secretary
Kimberly Bartlett, Secretary/Receptionist
Sandie Gibson, Information Technology Support Specialist
Kathy Mulholland, Information Technology Manager
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 STAFF

Mike Lapointe, Chief Biologist
Catherine Michielsens, Quantitative Fisheries Biologist

Stock Identification Group

Ian Guthrie, Head
Holly Anozie, Scale Lab Assistant
Maxine Forrest, Senior Scale Analyst
Steve Latham, Sockeye Stock Identification Biologist
Julie Sellars, Scale Analyst
Zac Semeniuk, Resource Management Technician
Bruce White, Pink Stock Identification Biologist

Stock Monitoring Group

Jim Cave, Head
Keith Forrest, Test Fishing Biologist
Andrew Gray, Hydroacoustic Biologist
Fiona Martens, Hydroacoustic Technician
Brendan Reddington, Hydroacoustic Technician (Term)
Yunbo Xie, Hydroacoustic Scientist