2006

Report of the Fraser River Panel to the Pacific Salmon Commission on the 2006 Fraser River Sockeye Salmon Fishing Season

Prepared by the

Pacific Salmon Commission

March 2011

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IN MEMORIUM

Murray Chatwin
October 1, 1947 – November 6, 2006

Murray Chatwin was a man of vision and integrity, demonstrating his leadership by diplomatically influencing consensus on difficult issues. In addition to his considerable background in the industry, he strived to learn and understand the biology and science of the resource.

Murray Chatwin was born in Powell River, British Columbia, on October 1, 1947. Growing up in Powell River, Murray excelled in various sports and school. He was a true student of hockey, and his love for the game stayed with him throughout his life as a both a player and a coach in minor hockey. Murray earned a Bachelor of Commerce in Economics from the University of British Columbia in 1972. He married Bonnie in 1979. Together they had a son, Michael, and a daughter, Chaslynn. He was a dedicated husband and father for 26 years.

Murray began his employment with Ocean Fisheries Limited in 1969 while a student at University. Through his career in the fishing industry he was deckhand on a packer, vessel master, fleet manager and Senior Vice President of Production at Ocean Fisheries. Murray was a licensed Ship's Master and ultimately became responsible for the company's fishing fleet, overseeing all of its salmon, herring and groundfish operations in British Columbia.

Because of his background in the fishing industry and the respect of his peers and government, Murray was appointed to numerous industry committees and groups. These included the Pacific Fisheries Resource Conservation Council, Central Coast Advisory Board, South Coast Advisory Board, Groundfish Trawl Special Industry Committee (GSIC), Groundfish Development Authority, BC Seafood Alliance, and C-CIARN Fisheries National Advisory Committee. He was appointed to the Fraser River Panel of the Pacific Salmon Commission in 1995.

During his tenure on these boards and committees, difficult issues arose that resulted in conservation initiatives for various species of fish that imposed constraints on the fishing industry. Murray recognized the need to change fishing practices and he showed leadership in developing various initiatives including individual quotas, stricter enforcement of catches, sharing amongst the industry, smaller fleet sizes and Marine Stewardship Certification (MSC). He recognized the importance of separating the socioeconomic issues from fisheries management. During his appointment to the Fraser River Panel, Murray recognized that commercial fisheries would have to radically change to adapt to the increased constraints imposed by conservation. He understood the need for smaller and selectively targeted openings.

Speaking before the Standing Committee on Fisheries and Oceans during the 37th Parliament, Murray emphasised concerns about the early upstream migration of Fraser River Late-run sockeye, which included the Adams River run. He noted "…the situation has to be seen in the

broad context of risk to the continuity and survival of future stocks, not simply in terms of availability of fishing opportunities…". He urged that sufficient funding be provided to fully investigate the science of this phenomenon. He was recognized for his continued support to ensure a better fishery for all Canadians.

Murray died prematurely with dignity on November 6, 2006 after a fierce battle with pancreatic cancer. Murray's considerable contributions, leadership and smile will be missed by family friends and colleagues. Murray's wife says he would advise we take time for significant relationships in our life and keep up the good fight for the fish and fishing industry.

REPORT OF THE
FRASER RIVER PANEL
TO THE PACIFIC SALMON COMMISSION
ON THE 2006 FRASER RIVER SOCKEYE
SALMON FISHING SEASON

2006 PANEL MEMBERS AND ALTERNATES

UNITED STATES

J. Long, Chair
Washington Department of Fish and Wildlife

D. Cantillon
National Marine Fisheries Service

B. Kehoe
Commercial salmon fishing industry

L. Loomis
Treaty Indian tribes

R. Charles (Alternate)
Treaty Indian tribes

J. Giard (Alternate)
Reefnet fisher

T. Scott (Alternate)
Washington Department of Fish and Wildlife

T. Tynan (Alternate)
National Marine Fisheries Service

CANADA

P. Ryall, Vice-Chair
Fisheries and Oceans Canada

M. Chatwin
Salmon processing industry

M. Griswold
Troll fisher

T. Lubzinski
Gillnet fisher

K. Malloway
First Nations

L. Wick
Purse seine fisher

B. Assu (Alternate)
Purse seine fisher

T. Bird (Alternate)
Sport fisher

R. Brahniuk (Alternate)
Fisheries and Oceans Canada

L. Rombough (Alternate)
Gillnet fisher

P. Sakich (Alternate)
Troll fisher

M. Shepert (Alternate)
First Nations

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FISHERIES MANAGEMENT DIVISION

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PACIFIC SALMON COMMISSION

March 2011

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Pre-season Planning

1. For Fraser River sockeye salmon, pre-season expectations were for a median abundance of 17,357,000 fish, an escapement target of 6,992,000 spawners and a Johnstone Strait diversion rate of 67%. There are no significant returns of Fraser River pink salmon in even years.

2. Pre-season spawning escapement goals established by Canada's spawning escapement plan were 83,000 Early Stuart, 521,000 Early Summer, 2,863,000 Summer and 225,000 Birkenhead sockeye (Table 1). In addition, Management Adjustments (MAs) of 264,000 Early Summer and 143,000 Summer-run sockeye were added to the spawning escapement targets to increase the likelihood of achieving the targets. These MAs were based on relationships between river conditions (discharge and temperature) as they relate to historic differences between lower river and upriver escapement estimates.

3. For Late-run sockeye, the Panel assumed a continuation of the early upstream migration behaviour and the associated high mortality that has occurred since 1996. The Panel adopted a flexible approach to the management of Late-run sockeye salmon by combining Canada's spawning escapement plan with a MA based on the historic relationship between upstream migration timing and en route mortality. Based on pre-season expectations of abundance, the Late-run spawning escapement target (excluding Birkenhead) was 3,300,000 fish (Table 1). Using historic data for the 2006 and 2007 cycle lines (i.e., Adams dominant cycle lines), the date that 50% of the population will have migrated upstream past Mission was projected to be September 9. This timing estimate generated a predicted MA of 1,485,000 fish to be added to the spawning escapement target, which corresponds to a 31% difference between lower river and upriver escapement estimates. For pre-season planning purposes, this resulted in a Late-run exploitation rate target of 41%. This target was expected to change during the in-season management period as return abundances, escapement targets and MAs were updated. For Canadian fisheries, the exploitation rate on Late-run Cultus sockeye was further constrained to 30% to meet conservation needs for this stock. Because a substantial return abundance of Late-run sockeye was expected, a large-scale marine tagging study was conducted along with other research programs to help determine the causes and quantify the consequences of early river-entry behaviour.

4. The projected Total Allowable Catch (TAC, Table 1) based on the median abundance forecast was 7,953,000 sockeye, of which 1,312,000 were allocated to the United States based on a 16.5% share. There were no paybacks owed from previous years.

5. Pre-season modeling showed it was unlikely the total available Summer-run TAC would be harvested, due to restrictive escapement targets for co-migrating Early Summer and Late-run stocks.

6. The Panel adopted a management plan and fishery regime before the fishing season, including the Principles and Constraints, Guidelines to Address Late Run Concerns, Panel Management Process and Regulations(Appendices B through E).

In-season Management Considerations

7. All sockeye management groups arrived later than expected (Figure 3), which delayed the start-up of fisheries in both countries by 4-8 days. Summer-run sockeye returned substantially below forecast, which further delayed larger impact fisheries in marine waters until the more abundant Late-run stocks arrived. As a general trend, in-season downgrades of Summer-run abundance occurred after most of the harvest had occurred, resulting in shortfalls in in-season escapement estimates relative to targets.

8. Final in-season estimates of Late-run sockeye abundance decreased to about 60% of the pre-season forecast when daily abundances projected from marine test fisheries were not observed by the Mission hydroacoustic program. The reduced estimates of Late-run abundance occurred late in the season after most fisheries were complete (Table 2), and gave the

impression that the Late-run (and Cultus) exploitation rate target had been exceeded by a significant amount. However, post-season estimates of actual abundance on the spawning grounds were significantly larger than in-season Mission projections, which indicated the Mission estimates were biased low. A post-season review did not draw firm conclusions as to the causes for this bias, but the most plausible explanation was that extremely low river flows in 2006 may have caused changes in fish behavior including increased boat avoidance, which would have reduced the detection of sockeye by the PSC's hydroacoustic equipment at Mission (Appendix I). Final post-season estimates of Late-run abundance (Table 8) were similar to pre-season forecast levels, resulting in exploitation rates and spawning escapements that were very close to target values.

9. Record low and near-record low Fraser River flows were experienced throughout the summer and river temperatures were higher than average (Figure 5). However, the later-than-normal migration meant that most sockeye migrated up the river when river temperatures were decreasing, so individual sockeye stocks were exposed to temperatures that were not much warmer than they would normally experience. As a consequence, in-season MA factors changed very little relative to pre-season expectations. The one exception was Early Stuart sockeye, which experienced temperatures warm enough to cause a significant increase in the predicted MA by the end of July.

Run Size, Catch and Escapement

10. Returns of adult Fraser sockeye totalled 12,979,000 fish (Tables 8 and 9), 25% lower than the median pre-season forecast. Divided into management groups, adult returns totalled 56,000 Early Stuart, 1,818,000 Early Summer, 2,512,000 Summer, 635,000 Birkenhead and 7,958,000 Late-run sockeye. Although the Early Stuart run returned at approximately two-thirds of the median forecast, no directed Early Stuart fishing was planned and so the smaller return did not affect management decisions. Early Summer-run sockeye returned well above forecast, while Summer-run sockeye returned at only 35% of the median forecast. Among Summer-run stocks, Chilko sockeye dominated the returns, followed by Quesnel. The poor Summer-run return was primarily due to a very low abundance of Quesnel sockeye – 719,000 fish compared to the median forecast of 4,613,000 fish, or 16% of the forecast abundance. The poor Quesnel returns were likely due to density-dependent processes caused by the record high spawning populations in the 2002 and 2003 brood years that resulted in the migration of extremely small smolts to sea in 2004. Birkenhead returns exceeded the pre-season forecast, while Late-run returns were very close to the median forecast. Among Late-run stocks, the largest component was Late Shuswap, followed by Weaver/Cultus and Harrison stock groups.

11. Catches of Fraser River sockeye salmon in all fisheries totalled 5,439,000 fish, including 4,572,000 fish caught by Canada, 727,000 fish by the United States and 140,000 fish by test fisheries (Table 8). The Canadian catch included 3,247,000 fish in commercial, 1,146,000 fish in First Nations, 172,000 fish in recreational and 7,000 fish in ESSR fisheries (Excess Salmon to Spawning Requirements). In Washington, Treaty Indian fishers caught 491,000 fish (includes ceremonial catch of 4,500 sockeye) and Non-Indian fishers caught 216,000 fish for a Washington total of 708,000 sockeye, while 20,000 Fraser sockeye were harvested in Alaska.

12. DFO's near-final estimates of spawning escapements to streams in the Fraser River watershed totalled 4,661,000 adult sockeye (Tables 8 and 9). This escapement was 54% lower than the brood year (2002) escapement of 10,201,000 adults, but higher than escapements in the previous two years on this cycle (1994 and 1998). Compared to the brood year, spawning escapements were 44% higher for Early Stuart, 14% lower for Early Summer, 79% lower for Summer, 32% higher for Birkenhead and 45% lower for Late-run stocks. Neither Quesnel nor Birkenhead sockeye were enumerated in 2002, so escapements in the above comparisons were projected from Mission estimates for these two stock groups. The substantial Late-run escapement was due to large numbers of Late Shuswap spawners (2,898,000 fish), near the average for the dominant cycle line since 1948. Spawning success of female sockeye in the Fraser watershed averaged 84%.

13. The annual diversion rate through Johnstone Strait was 65% for Fraser sockeye.

Achievement of Objectives

14. 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.

15. In-season management decisions are based on targets for spawning escapement, which are represented in-season by potential spawning escapement targets (i.e., spawning escapement targets plus MAs). In-season estimates of potential spawning escapement (i.e., Mission escapement minus First Nations and recreational catches above Mission) were slightly higher than the target for Early Stuart (7%) and Early Summer (5%) sockeye, but below the targets for Summer (44% under), Birkenhead (13% under) and Late-run sockeye (24% under, Table 12). These results are mainly due to Summer and Late-run abundance estimates that decreased after the completion of marine fisheries.

16. Upriver estimates of spawning escapement were below post-season targets for the earlier runs of Fraser sockeye: Early Stuart – 33% under, Early Summers – 46% under and Summers – 58% under (Table 13). The target for Birkenhead was exceeded (14% over) and for Late-run sockeye was almost achieved (2% under). In total, spawning ground estimates were 1,505,000 fish or 24% less than the target. There are a number of causes for this result. First, in-season escapement targets were too low due to the negative bias in in-season Mission escapement estimates (point 8, above) and the corresponding bias in run-size assessments on which escapement targets are based. Second, for Early Stuart sockeye, although the DBE was less than predicted by the MA models, the catch in Fraser River First Nations fisheries was larger than planned. Third, for Early Summer and Summer runs, differences between lower river and upriver escapement estimates (DBEs) were much higher than accounted for by the in-season MAs derived from environmental models.

17. The exploitation rate for Cultus Lake sockeye was 25%, below the 30% limit for this stock.

18. Based on the TAC calculation method set out in Annex IV, Chapter 4 of the Pacific Salmon Treaty, both countries exceeded their available TACs (Table 14). In this calculation, the allowable catch is fixed on the date that Panel control of the last U.S. Panel Area was relinquished (September 30 in 2006), while catches are the post-season accounted totals. United States (Washington) catches exceeded their share of the TAC by 335,000 Fraser sockeye and Canada caught 2,287,000 sockeye more than their share.

19. In United States Panel Areas, Treaty Indian (13,000 fish over) and Non-Indian (13,000 fish under) fishers were close to the domestic allocation targets for Fraser sockeye (Table 15).

20. According to Canadian domestic allocations, purse seines in Area B caught 5,000 fish more, Area D gillnets caught 110,000 fish less, Area E gillnets caught 94,000 fish more, Area G trollers caught 32,000 fish more and Area H trollers caught 21,000 fish less than their respective allocations (Table 16).

21. By-catches of non-Fraser sockeye and pink salmon in commercial net fisheries regulated by the Fraser River Panel totalled 350 sockeye and 1,000 pink salmon in 2006 (Table 17). Catches of other Fraser and non-Fraser salmon species included 8,900 chinook, 1,600 coho, 460 chum and 40 steelhead.

Allocation Status

22. By Panel agreement, no paybacks were carried forward from 2005 to 2006, and no paybacks were generated in 2006 to be carried forward to 2007 (Table 18).

II. FRASER RIVER PANEL

In 2006, the Panel operated under the terms of Annex IV, Chapter 4 of the Pacific Salmon Treaty between Canada and the United States (U.S.) and the "Commission Guidance to the Fraser River Panel", as revised in February 2005. The Treaty specifies that the Fraser River Panel is responsible for in-season management of commercial fisheries that target Fraser River sockeye and pink salmon within the Panel Area (Figure 1), including net fisheries in both countries and the Canadian troll fishery in the Strait of Georgia. Coordination of directed harvest of other salmon species and stocks intercepted in south coast areas is the responsibility of the Southern Panel and the Pacific Salmon Commission (PSC). Regulation of Southern Panel related fisheries is the responsibility of the appropriate agencies in each country.

Prior to the fishing season, the Fraser River Panel recommends a fishery regime and a management plan for Panel Area fisheries to the Pacific Salmon Commission (PSC). The plan is based on: (1) abundance and timing 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 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.

The pre-season management plan identifies the approximate pattern of fishery openings required to achieve the Panel objectives given pre-season expectations. However, the Panel may substantially change this template based on in-season assessments by PSC staff (Staff, Appendix K) of sockeye and pink salmon run strength, migration timing and route, in-river migration abundance (Mission passage), and management adjustments. Thus, the Panel responds to deviations from pre-season expectations in their weekly fishing plans and most substantive fishing decisions are based on in-season rather than pre-season assessments. The Fraser River Panel Technical Committee (Appendix L) 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.

III. PANEL MANAGEMENT ACTIVITIES

Abundant sockeye returns were expected in 2006, with median forecasts of 7.2 million Summer-run fish and 8.3 million Late-run fish. The Panel added a large MA of about 1.5 million fish to the Late-run escapement target during the pre-season planning process to account for potential en route migration losses related to the continuation of early upstream migration behaviour. Even with the large MA, the total allowable Late-run exploitation rate was higher than in recent past years, partly due to the large forecast return of Late-run stocks but also to evidence of better Late-run in-river migration survival and subsequent spawning success in Late Shuswap dominant years (2006 and 2007 cycle lines) compared to Late Shuswap off-line years (2004 and 2005 cycle lines). The pre-season management plan showed significant harvest was available for fisheries that target both Summer and Late-run sockeye stocks, leading to optimism among user groups. Although the bilateral catch of Late-run sockeye was limited to about 42% of the forecast run, Canadian fisheries below the Vedder / Fraser River confluence were further constrained by a harvest ceiling of 30% on the Cultus component of the Late run.

A. Pre-season Planning

Canada presented the Panel with run-size forecasts for Fraser River sockeye salmon, including different probabilities (10%, 25%, 50%, 75% and 90%) that the actual run would exceed specific run size estimates (Appendix B, Table 1). The Panel used the median (i.e., 50%

probability level) forecast of 17.4 million Fraser River sockeye for planning purposes (Table 1), thereby accepting equal probability that the actual run would be above or below the forecast.

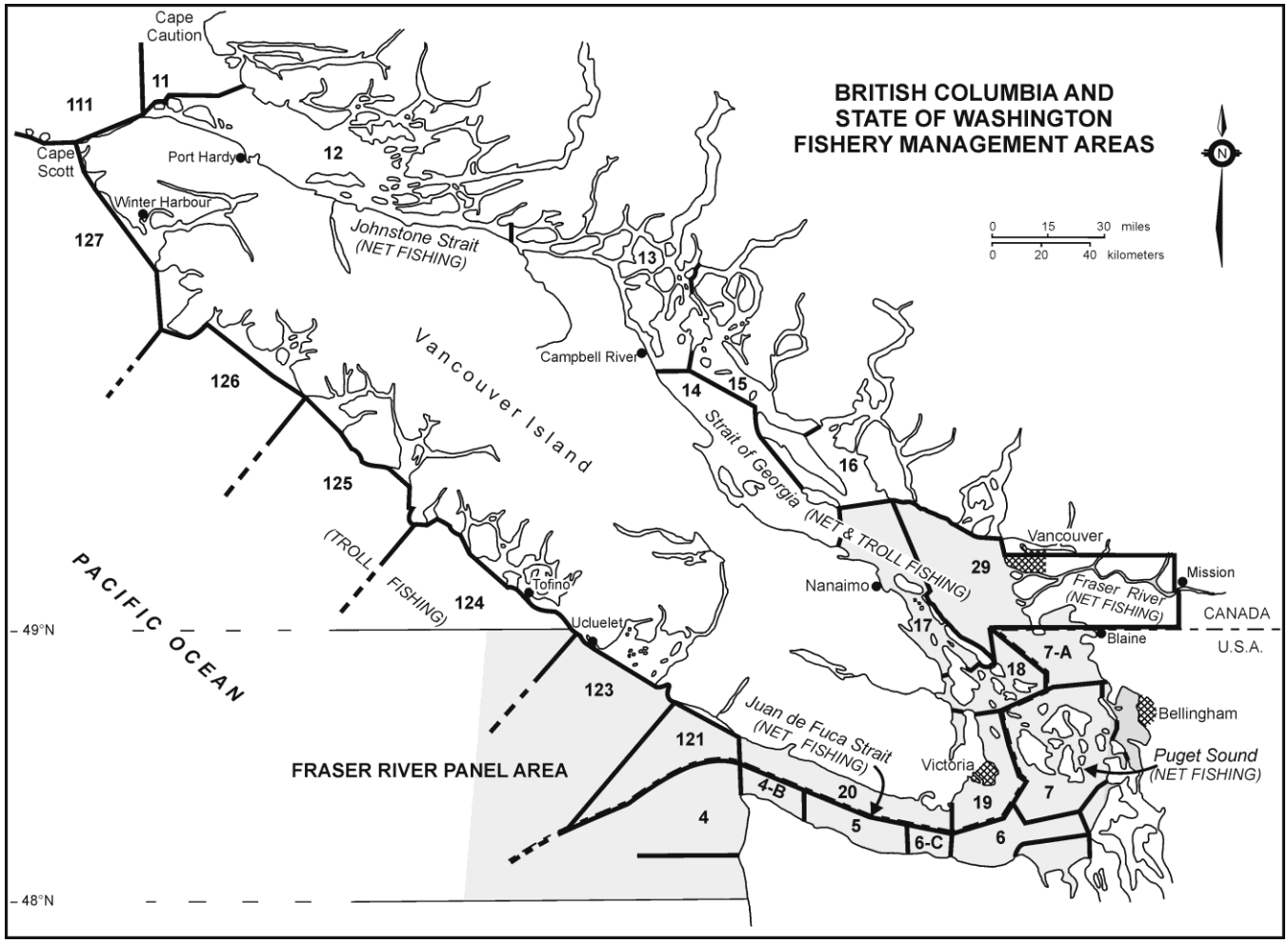

Figure 1. Fishery management areas and commercial gear used in the Fraser River Panel Area and Canadian south coast waters.

Table 1. Pre-season forecasts of total abundance, spawning escapement targets and other deductions, and total allowable catches of Fraser River sockeye salmon in 2006.

		Deductions				
Management Group	Forecast Abundance (median)	Spawning Escapement Target	Management Adjustment	Test Fishing	Aboriginal Fishery Exemption	Total Allowable Catch
Early Stuart	84,000	82,500	0	1,500	0	0
Early Summer	1,303,000	521,000	264,000	19,000	45,200	454,000
Summer	7,158,000	2,863,000	143,000	69,000	292,400	3,790,000
Birkenhead	562,000	225,000	0	1,500	2,300	333,000
Late	8,250,000	3,300,000	1,485,000	29,000	60,100	3,376,000
Total	17,357,000	6,992,000	1,892,000	120,000	400,000	7,953,000

Canada also presented the Panel with a status report on the "Fraser River Sockeye Spawning Initiative". The goals of the spawning initiative included the provision of: a) guidelines for setting Fraser River sockeye escapement targets; b) a long-term strategy for establishing escapement

targets based on a consistent set of objectives and assumptions; and c) implementation guidelines with in-season adjustment mechanisms. Canada subsequently released an escapement plan to the Panel, based on the Spawning Initiative guidelines as ratified by a domestic consultation process. Proposed escapement targets for the four run-timing groups were: Early Stuart – 82,500 fish, Early Summer – 521,000 fish, Summer – 2.9 million fish, Birkenhead – 225,000 fish and Late-run sockeye – 3.3 million fish (Table 1, Appendix B, Table 2).

DFO's Environmental Watch Program provided the Panel with long-range projections of Fraser River discharge and temperature that predicted lower than normal discharge levels and warmer than normal water temperatures during sockeye migration. However, given the uncertain nature of long range forecasts , the Panel asked Staff to provide them with two sets of MAs for Early Stuart, Early Summer and Summer-run groups, with one set based on average historic DBEs and the second set based on the forecast river discharges and temperatures. Because the MAs based on long-range forecasts of river conditions were considered more uncertain, the Panel adopted the first set of MA factors as follows: Early Stuart – 0.89 (the numerical MA was zero because at the forecast abundance the entire run was required for spawning escapement), Early Summer – 0.5067 (264,000 fish) and Summer-run sockeye – 0.05 (143,200 fish) (Table 1).

For Late-run sockeye two MA options were considered by the Panel. The first option used a MA model which related historical DBEs on the 2002 and 2003 cycle lines to the upstream migration date. This model predicted a MA factor of 0.45 based on the forecast 50% Mission date of September 9, which was based on historical Late-run marine timing and on Late-run upstream migration behaviour for Late Shuswap dominated cycle lines (2002 and 2003) since 1995. The second option used relationships between in-river migration survival and migration timing that were derived from acoustic tagging programs conducted in 2002 and 2003. These models predicted a very similar overall MA factor. The tagging based method was more complicated to implement because it required the ability to predict the daily migration abundance of Late-run sockeye. Thus, the Panel adopted a pre-season MA of 1.5 million fish (Table 1), based on the first method, but requested that in-season updates be generated using both methods for on-going review by the Panel.

Pre-season expectations of migration parameters included a 67% diversion rate of Fraser sockeye through Johnstone Strait (Figure 2), and Area 20 migration dates of July 3 for Early Stuart, August 1 for Early Summer, August 9 for Summer, August 14 for Birkenhead and August 15 for Late-run stocks. These Area 20 dates are indices of marine migration timing, and represent historical average dates when 50% of the total run would have entered Juan de Fuca Strait (Canadian Area 20) if the entire run had migrated via that route. Projected daily abundance patterns generated from these dates are shown in Figures 3 and 4.

TACs and international harvest shares in 2006 were calculated according to Annex IV, Chapter 4 of the Pacific Salmon Treaty and the "Commission Guidance to the Fraser River Panel" as revised in February 2005. The U.S. (Washington) share was 16.5% of the Total Allowable Catch (TAC) of Fraser River sockeye salmon. Pre-season TAC projections (almost 8.0 million fish) based on the median (50% probability level) run-size forecast and agreed deductions are shown in Table 1. The corresponding allocation of the pre-season TAC to Washington fishers was 1.3 million fish. In terms of domestic goals, Treaty Indian fishers were allocated 67.7% and Non-Indian fishers the remaining 32.3% of the U.S. share of Fraser River sockeye.

Within Canada, pre-season shares were divided among non-commercial sectors as follows: in-river First Nations – 749,000 fish, marine First Nations – 260,000 fish, in-river recreational – 200,000 fish and marine recreational – 15,000 fish, totalling 1.2 million fish. In the commercial sector the total share of 5.8 million fish was divided as follows: 47.5% for Area B purse seines, 18.5% for Area D gillnets, 22.0% for Area E gillnets, 4.5% for Area G trollers and 7.5% for Area H trollers.

Pre-season management plans for Panel Area fisheries were developed by the Panel using the Fishery Simulation Model[1]. This model helps the Panel to evaluate the impacts of various fishery options on the achievement of the management objectives. Model inputs include the forecast abundances, migration timing, diversion rates and MAs, plus the objectives for spawning escapement and catch allocation described above. To model Late-run impacts, the September 9 Mission date and MA factor of 0.45 (equivalent to -31% DBE) described above enabled the pre-season planning process to account for similar magnitudes of en route losses as observed since 1995 in years when Late Shuswap was the dominant Late-run stock.

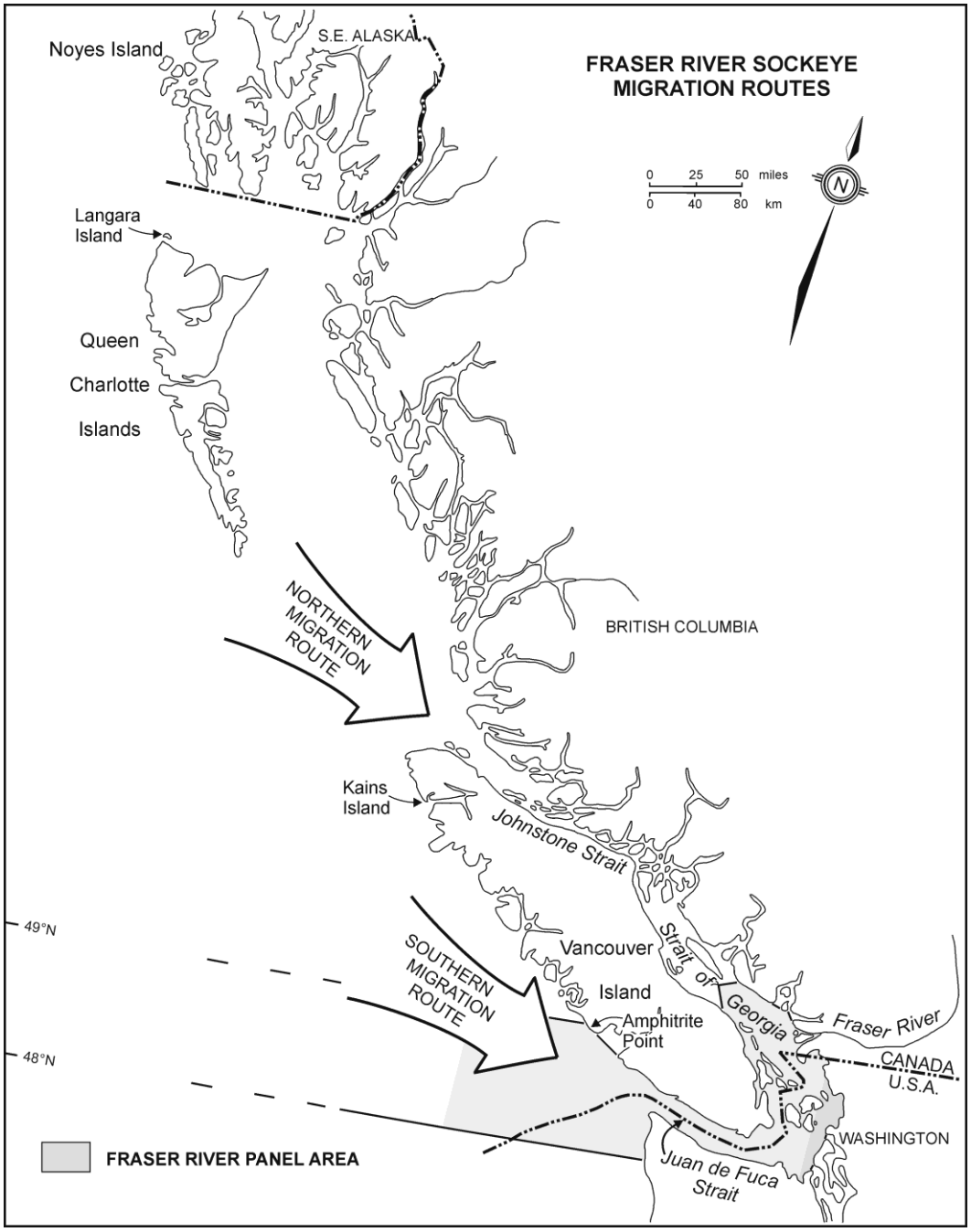

Figure 2. The northern (Johnstone Strait) and southern (Juan de Fuca Strait) routes for sockeye and pink salmon migrating to the Fraser River.

[1] 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.

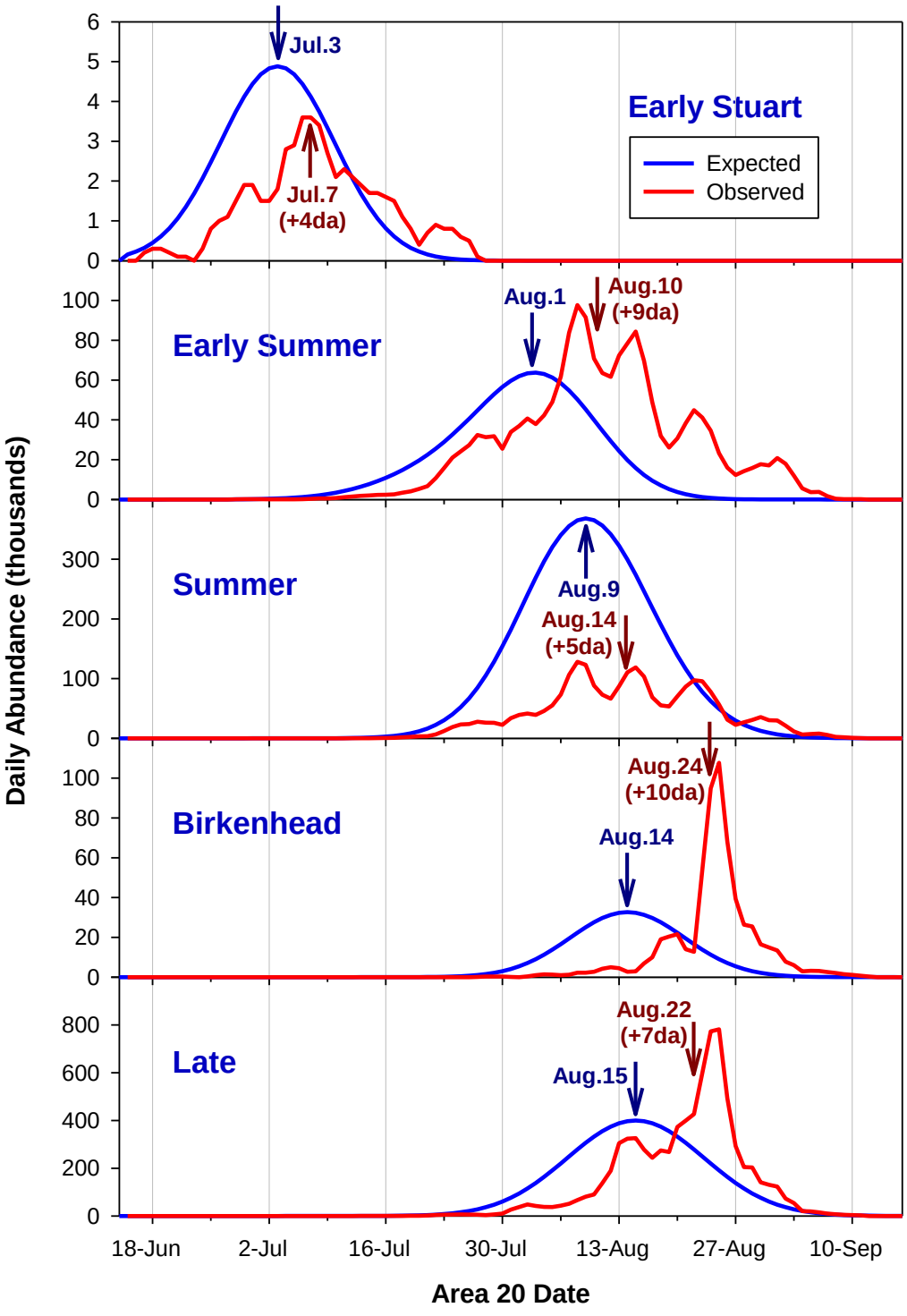

Figure 3. Pre-season projections and post-season reconstructions of daily abundance of Fraser River sockeye salmon by management group in 2006 (Area 20 date), including the observed 50% date and number of days difference with the pre-season expectation. This figure shows the general lateness of Fraser sockeye by management group and the very low Summer-run return compared to pre-season expectations.

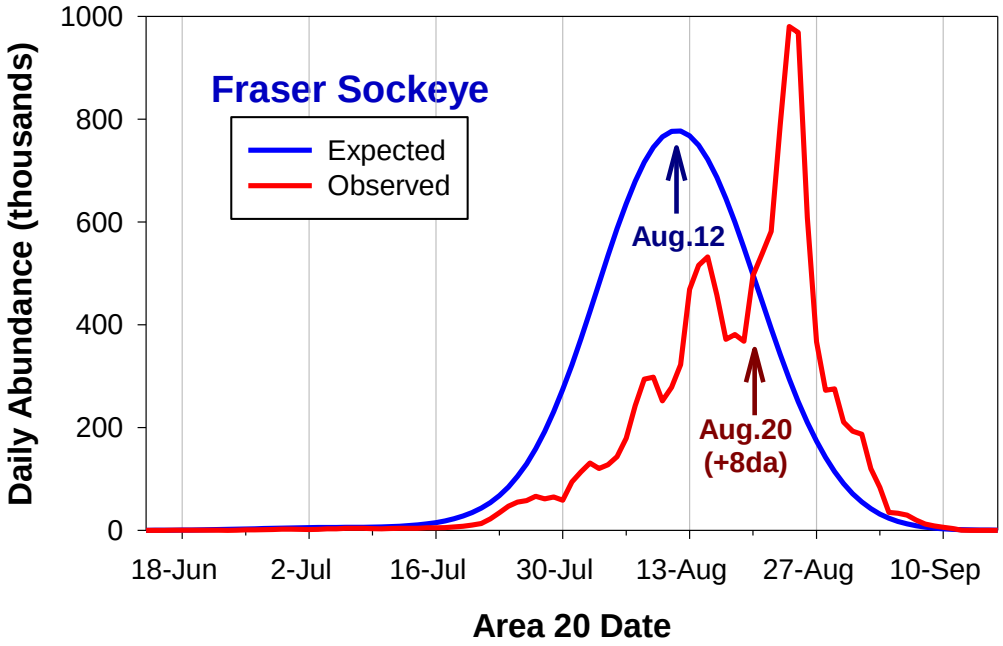

Figure 4. Pre-season projections and post-season reconstructions of daily abundance of Fraser River sockeye salmon in 2006 (Area 20 date), including the observed 50% date and number of days difference with the pre-season expectation.

Simulation modeling was used to examine alternative scenarios that focused harvest on Summer-run sockeye, while meeting escapement targets for weaker co-migrating stocks. The most successful simulations at achieving Early Stuart and Early Summer-run escapement goals were those in which fishing was restricted early in the season. However, the substantial allowable harvest of Late-run stocks allowed for an expected harvest of larger fractions of the Summer-run TAC than in recent years when more restrictive Late-run constraints were implemented.

Based on the simulation results the Panel adopted a management plan, which included the "2006 Fraser River Panel Management Plan Principles and Constraints", "Guidelines for Pre-Season Fraser Sockeye Fishing Plans To Address Late Run Concerns", "2006 Fraser Panel Management Process" and "2006 Regulations" (Appendices C, D, E and F). Fisheries were expected to start during the week of July 23 – 29 in both U.S. and Canadian Panel waters. However, it was understood that this schedule would be adjusted if in-season assessments deviated from pre-season expectations.

During the pre-season planning process, both countries identified salmon stocks for which they had conservation concerns, and that these concerns would influence management decisions for Fraser sockeye directed fisheries. Canada identified Thompson coho salmon, lower and upper Strait of Georgia coho salmon, Johnstone Strait coho salmon, summer-run chum salmon, Thompson River steelhead, and west coast Vancouver Island and Harrison River chinook salmon as stocks of concern. Similarly, the United States highlighted concerns for Hood Canal summer-run chum and Puget Sound chinook salmon.

B. In-season Management

The Fraser River Panel met 25 times between June 29 and September 29, to discuss run status and enact In-season Orders (Appendix G) to regulate fisheries directed at Fraser River sockeye salmon in Panel Areas.

The 2006 fishery management season was difficult for a number of reasons. First, final in-season estimates of sockeye marine timing were later than average, ranging from 9 days late for

Early Summer stocks, 5 days late for Summer-run stocks and 7 days late for Late-run stocks (Figures 3 and 4). This delayed Staff's ability to generate in-season abundance estimates by management group. Second, water temperatures were warmer than average (Figure 5), so larger MAs were established to increase the probability of achieving the spawning escapement objectives. Third, the final in-season estimate of Summer-run abundance was only 28% of the pre-season forecast. This delayed the start-up of fisheries and resulted in poor overall catches relative to pre-season expectations. It was recognized early in the Summer-run migration that the total abundance was below forecast (the 75 p-level forecast was adopted on Aug 11, 3-days before the forecast peak in Area 20). However, the extreme weakness of this run was not fully understood until the first week of September after all Panel fisheries had concluded, when the Panel adopted a final in-season abundance estimate of 2.0 million fish. The late response to the low Summer-run estimates resulted in a significant shortfall in the potential spawning escapement (PSE = Mission escapement minus catch above Mission) of Summer-run stocks compared to the final in-season target (PSE Target = spawning escapement target plus the MA). Fourth, the late arrival and irregular migration profile of Late-run stocks made it difficult to accurately evaluate their return strength, which ultimately resulted in some over-harvest of this run relative to catch objectives (discussed later in Achievement of Objectives section).

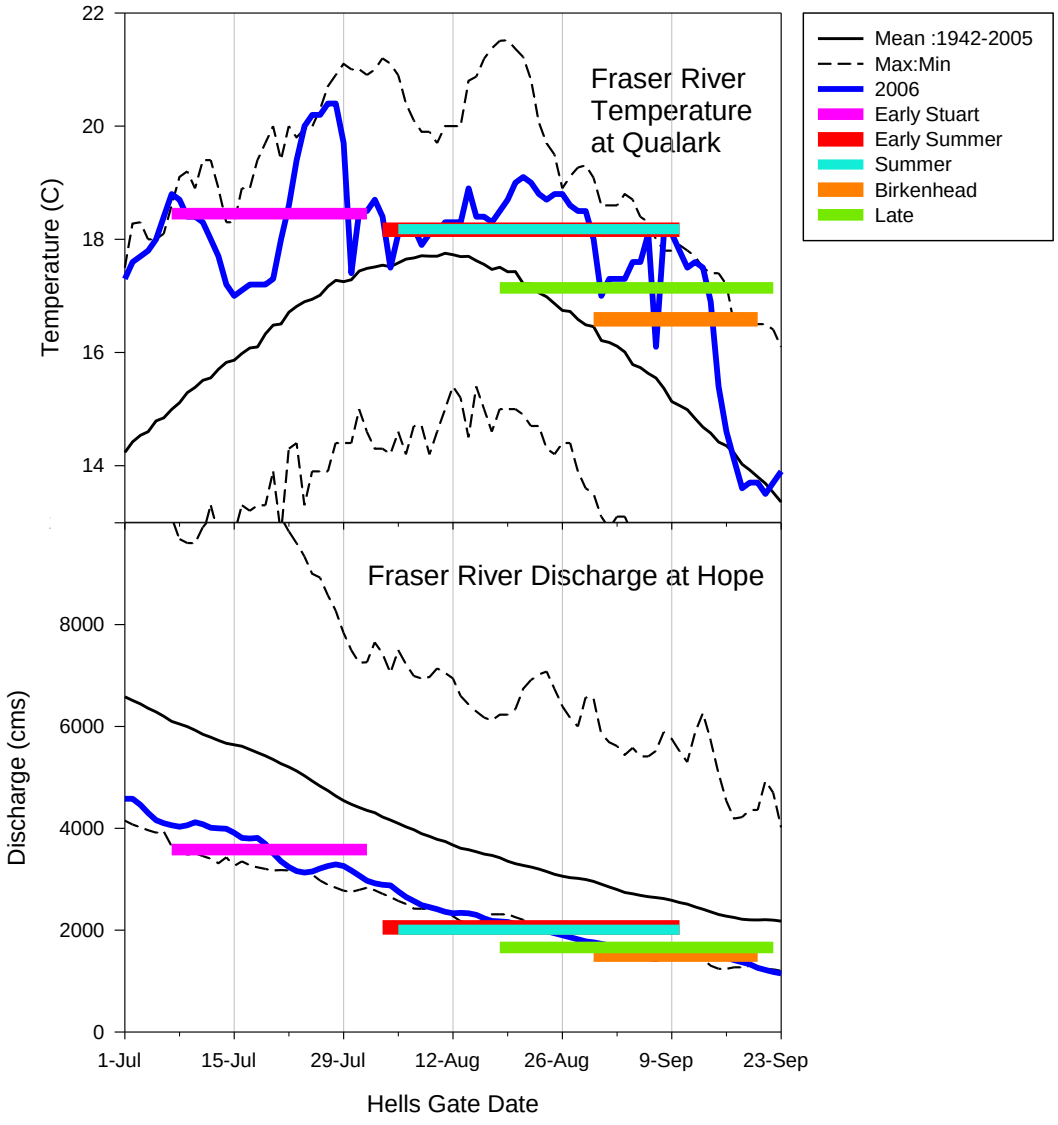

Figure 5. Fraser River temperatures and discharges measured near Hope in 2006, with mean temperatures and discharges during the central 90% of the migration of each run-timing group (excluding Pitt and Birkenhead).

The main weekly events of the season are summarized below. Table 2 shows the pre-season assumptions, weekly estimates and end-of-season estimates when control of the last Panel Area was relinquished. This synopsis focuses on stock evaluations and recommendations by Staff, and on decisions made by the Panel.

Data available at the first in-season Panel meeting on June 30 indicated that both marine and in-river abundances of Early Stuart sockeye were below expected levels for the date at both the 50% and 75% forecast levels.

Table 2. Pre-season and weekly in-season updates of management information for Fraser River sockeye salmon in 2006. In addition to total abundance, spawning escapement target, management adjustment and Total Allowable Catch, this table shows estimates of Mission escapement-to-date, migration timing and diversion rate, and compares catch-to-date with the available catch (total abundance minus Spawning escapement target and management adjustment).

			TAC					Available			50% Migration Date		Weekly JS
Date	Management Group	Total Abundance	Spawning Escapement Target	Management Adjust.	Test Fishing	Aboriginal Fishery Exemption	Total Allowable Catch	Harvest (incld. TF + AFE)	Catch to date	Mission Escape. to date	Area 20	Mission	Diversion Rate
Pre-season	Early Stuart	84,000	82,500	0	1,500	0	0	1,500			3-Jul		
	Early Summer	1,303,000	521,000	264,000	19,000	45,200	453,800	518,000			1-Aug		
	Summer	7,158,000	2,863,000	143,000	69,000	292,400	3,790,600	4,152,000			9-Aug		
	Birkenhead	562,000	225,000	0	1,500	2,300	333,200	337,000			14-Aug		
	Late	8,250,000	3,300,000	1,485,000	29,000	60,100	3,375,900	3,465,000			15-Aug	8-Sep	
	Sockeye	**17,357,000**	**6,991,500**	**1,892,000**	**120,000**	**400,000**	**7,953,500**	**8,473,500**					
Jun.25-Jul.1 In-season	Early Stuart	84,000	82,500	0	1,500	0	0	1,500	200	1,400	3-Jul		
	Early Summer	1,303,000	521,000	264,000	19,000	45,200	453,800	518,000	0	0	1-Aug		
	Summer	7,158,000	2,863,000	143,000	69,000	292,400	3,790,600	4,152,000	0	0	9-Aug		
	Birkenhead	562,000	225,000	0	1,500	2,300	333,200	337,000	0	0	14-Aug		
	Late	8,250,000	3,300,000	1,485,000	29,000	60,100	3,375,900	3,465,000	0	0	15-Aug	8-Sep	
	Sockeye	**17,357,000**	**6,991,500**	**1,892,000**	**120,000**	**400,000**	**7,953,500**	**8,473,500**	**200**	**1,400**			na
July 2-8 In-season	Early Stuart	84,000	82,500	0	1,500	0	0	1,500	600	7,600	3-Jul		
	Early Summer	1,303,000	521,000	264,000	19,000	45,200	453,800	518,000	0	500	1-Aug		
	Summer	7,158,000	2,863,000	143,000	69,000	292,400	3,790,600	4,152,000	0	0	9-Aug		
	Birkenhead	562,000	225,000	0	1,500	2,300	333,200	337,000	0	0	14-Aug		
	Late	8,250,000	3,300,000	1,485,000	29,000	60,100	3,375,900	3,465,000	0	0	15-Aug	8-Sep	
	Sockeye	**17,357,000**	**6,991,500**	**1,892,000**	**120,000**	**400,000**	**7,953,500**	**8,473,500**	**600**	**8,100**			na
July 9-15 In-season	Early Stuart	84,000	82,500	0	1,500	0	0	1,500	900	33,800	3-Jul		
	Early Summer	1,303,000	521,000	264,000	19,000	45,200	453,800	518,000	100	2,100	1-Aug		
	Summer	7,158,000	2,863,000	143,000	69,000	292,400	3,790,600	4,152,000	0	0	9-Aug		
	Birkenhead	562,000	225,000	0	1,500	2,300	333,200	337,000	0	0	14-Aug		
	Late	8,250,000	3,300,000	1,485,000	29,000	60,100	3,375,900	3,465,000	0	0	15-Aug	8-Sep	
	Sockeye	**17,357,000**	**6,991,500**	**1,892,000**	**120,000**	**400,000**	**7,953,500**	**8,473,500**	**1,000**	**35,900**			na
July 16-22 In-season	Early Stuart	70,000	68,500	0	1,500	0	0	1,500	1,400	51,300	7-Jul		
	Early Summer	1,303,000	521,000	372,000	19,000	45,200	345,800	410,000	1,000	10,200	1-Aug		
	Summer	7,158,000	2,863,000	143,000	69,000	292,400	3,790,600	4,152,000	400	400	9-Aug		
	Birkenhead	562,000	225,000	0	1,500	2,300	333,200	337,000	0	0	14-Aug		
	Late	8,250,000	3,300,000	1,485,000	29,000	60,100	3,375,900	3,465,000	100	200	15-Aug	8-Sep	
	Sockeye	**17,343,000**	**6,977,500**	**2,000,000**	**120,000**	**400,000**	**7,845,500**	**8,365,500**	**2,900**	**62,100**			24%
July 23-29 In-season	Early Stuart	70,000	68,500	0	1,500	0	0	1,500	1,600	60,100	7-Jul		
	Early Summer	1,303,000	521,000	372,000	19,000	45,200	345,800	410,000	4,600	32,200	1-Aug		
	Summer	7,158,000	2,863,000	143,000	69,000	292,400	3,790,600	4,152,000	2,200	9,600	9-Aug		
	Birkenhead	562,000	225,000	0	1,500	2,300	333,200	337,000	0	300	14-Aug		
	Late	8,250,000	3,300,000	1,485,000	29,000	60,100	3,375,900	3,465,000	900	1,800	15-Aug	8-Sep	
	Sockeye	**17,343,000**	**6,977,500**	**2,000,000**	**120,000**	**400,000**	**7,845,500**	**8,365,500**	**9,300**	**104,000**			20%
Jul.30-Aug.5 In-season	Early Stuart	70,000	68,500	0	1,500	0	0	1,500	5,900	66,700	7-Jul		
	Early Summer	1,303,000	521,000	372,000	19,000	45,200	345,800	410,000	30,000	188,900	1-Aug		
	Summer	7,158,000	2,863,000	143,000	69,000	292,400	3,790,600	4,152,000	19,800	120,200	9-Aug		
	Birkenhead	562,000	225,000	0	1,500	2,300	333,200	337,000	100	700	14-Aug		
	Late	8,250,000	3,300,000	1,485,000	29,000	60,100	3,375,900	3,465,000	8,700	36,500	15-Aug	8-Sep	
	Sockeye	**17,343,000**	**6,977,500**	**2,000,000**	**120,000**	**400,000**	**7,845,500**	**8,365,500**	**64,500**	**413,000**			26%

Table 2, continued.

Date	Management Group	Total Abundance	TAC: Spawning Escapement Target	TAC: Management Adjust.	TAC: Test Fishing	TAC: Aboriginal Fishery Exemption	TAC: Total Allowable Catch	Available Harvest (incld. TF + AFE)	Catch to date	Mission Escape. to date	50% Migration Date: Area 20	50% Migration Date: Mission	Weekly JS Diversion Rate
August 6-12 In-season	Early Stuart	70,000	68,500	0	1,500	0	0	1,500	7,100	67,600	7-Jul		
	Early Summer	1,303,000	521,000	254,000	19,000	45,200	463,800	528,000	174,200	309,500	1-Aug		
	Summer	4,020,000	1,678,000	84,000	69,000	292,400	1,896,600	2,258,000	179,700	250,800	9-Aug		
	Birkenhead	562,000	235,000	0	1,500	2,300	323,200	327,000	6,100	3,400	14-Aug		
	Late	8,250,000	3,300,000	1,485,000	29,000	60,100	3,375,900	3,465,000	146,100	93,300	15-Aug	8-Sep	
	Sockeye	**14,205,000**	**5,802,500**	**1,823,000**	**120,000**	**400,000**	**6,059,500**	**6,579,500**	**513,200**	**724,600**			30%
August 13-19 In-season	Early Stuart	70,000	68,500	0	1,500	0	0	1,500	7,200	67,600	7-Jul		
	Early Summer	1,700,000	680,000	332,000	40,000	45,200	602,800	688,000	546,300	532,700	11-Aug		
	Summer	4,020,000	1,678,000	84,000	40,000	292,500	1,925,500	2,258,000	634,900	532,800	9-Aug		
	Birkenhead	562,000	235,000	0	1,500	2,200	323,300	327,000	52,400	5,100	14-Aug		
	Late	8,250,000	3,300,000	1,485,000	40,000	60,100	3,364,900	3,465,000	898,700	322,000	15-Aug	8-Sep	
	Sockeye	**14,602,000**	**5,961,500**	**1,901,000**	**123,000**	**400,000**	**6,216,500**	**6,739,500**	**2,139,500**	**1,460,200**			50-60%
August 20-26 In-season	Early Stuart	70,000	68,500	0	1,500	0	0	1,500	7,200	67,600	7-Jul		
	Early Summer	1,700,000	680,000	351,000	40,000	45,200	583,800	669,000	714,300	652,300	11-Aug		
	Summer	3,500,000	1,893,000	227,000	40,000	292,500	1,047,500	1,380,000	1,050,500	675,900	19-Aug		
	Birkenhead	562,000	225,000	0	1,500	2,200	333,300	337,000	133,400	16,100	14-Aug		
	Late	10,000,000	4,000,000	1,800,000	40,000	60,100	4,099,900	4,200,000	1,997,100	570,400	21-Aug	8-Sep	
	Sockeye	**15,832,000**	**6,866,500**	**2,378,000**	**123,000**	**400,000**	**6,064,500**	**6,587,500**	**3,902,500**	**1,982,300**			70-95%
Aug.27-Sep.2 In-season	Early Stuart	70,000	68,500	0	1,500	0	0	1,500	7,200	67,600	7-Jul		
	Early Summer	1,700,000	680,000	351,000	40,000	45,200	583,800	669,000	796,600	707,200	11-Aug		
	Summer	2,500,000	1,944,000	78,000	40,000	292,500	145,500	478,000	1,201,500	762,300	17-Aug		
	Birkenhead	562,000	225,000	0	1,500	2,200	333,300	337,000	184,000	43,400	14-Aug		
	Late	10,000,000	4,000,000	1,800,000	40,000	60,100	4,099,900	4,200,000	2,439,300	845,300	21-Aug	8-Sep	
	Sockeye	**14,832,000**	**6,917,500**	**2,229,000**	**123,000**	**400,000**	**5,162,500**	**5,685,500**	**4,628,600**	**2,425,800**			90%
Sep. 3-9 In-season	Early Stuart	70,000	68,500	0	1,500	0	0	1,500	7,200	67,600	7-Jul		
	Early Summer	1,450,000	580,000	294,000	32,000	45,200	498,800	576,000	813,000	732,700	9-Aug		
	Summer	2,000,000	1,792,000	36,000	32,000	292,500	0	172,000	1,248,700	813,400	14-Aug		
	Birkenhead	562,000	225,000	0	4,000	2,200	330,800	337,000	192,600	112,700	14-Aug		
	Late	7,500,000	3,000,000	1,350,000	65,000	60,100	3,024,900	3,150,000	2,825,400	1,452,300	21-Aug	8-Sep	
	Sockeye	**11,582,000**	**5,665,500**	**1,680,000**	**134,500**	**400,000**	**3,854,500**	**4,236,500**	**5,086,900**	**3,178,700**			na
Sep. 10-16 In-season	Early Stuart	70,000	68,500	0	1,500	0	0	1,500	7,200	67,600	7-Jul		
	Early Summer	1,450,000	580,000	294,000	32,000	45,200	498,800	576,000	820,100	757,000	9-Aug		
	Summer	2,000,000	1,792,000	36,000	32,000	292,500	0	172,000	1,266,200	824,200	14-Aug		
	Birkenhead	562,000	225,000	0	4,000	2,200	330,800	337,000	194,500	145,400	14-Aug		
	Late	7,500,000	3,000,000	1,350,000	65,000	60,100	3,024,900	3,150,000	2,962,300	1,907,000	21-Aug	8-Sep	
	Sockeye	**11,582,000**	**5,665,500**	**1,680,000**	**134,500**	**400,000**	**3,854,500**	**4,236,500**	**5,250,300**	**3,701,200**			na
Sep. 17-23 In-season	Early Stuart	70,000	68,500	0	1,500	0	0	1,500	7,200	67,600	7-Jul		
	Early Summer	1,450,000	580,000	294,000	32,000	45,200	498,800	576,000	820,900	763,500	9-Aug		
	Summer	2,000,000	1,792,000	36,000	32,000	292,500	0	172,000	1,271,200	833,400	14-Aug		
	Birkenhead	562,000	225,000	0	4,000	2,200	330,800	337,000	194,200	162,500	14-Aug		
	Late	7,500,000	3,000,000	1,350,000	65,000	60,100	3,024,900	3,150,000	2,978,800	2,019,000	21-Aug	8-Sep	
	Sockeye	**11,582,000**	**5,665,500**	**1,680,000**	**134,500**	**400,000**	**3,854,500**	**4,236,500**	**5,272,300**	**3,846,000**			na
Sep. 30 TAC Date	Early Stuart	70,000	68,500	0	1,500	0	0	1,500	7,200	67,600	7-Jul		
	Early Summer	1,450,000	580,000	294,000	32,000	45,200	498,800	576,000	820,900	763,500	9-Aug		
	Summer	2,000,000	1,792,000	36,000	32,000	292,500	0	172,000	1,271,200	833,800	14-Aug		
	Birkenhead	475,000	190,000	0	4,000	2,200	278,800	285,000	194,200	163,500	14-Aug		
	Late	4,720,000	1,888,000	1,227,000	65,000	60,100	1,479,900	1,605,000	2,991,600	2,036,800	20-Aug	4-Sep	
	Sockeye	**8,715,000**	**4,518,500**	**1,557,000**	**134,500**	**400,000**	**2,257,500**	**2,639,500**	**5,285,100**	**3,865,200**			na

During the week of July 2 – 8, Early Stuart sockeye appeared to be arriving later than normal and Mission escapements were below expectations for both Early Stuart (7,600 fish) and Chilliwack Lake sockeye (500 fish). An update of total Early Stuart abundance was deferred until

more information became available. Fraser River discharges were low and water temperatures were near record highs for the date (19°C).

Between July 9 – 15, marine test fishing catches in Juan de Fuca Strait began to increase, while catches in Johnstone Strait remained very low. Seal predation was interfering with test fishing catches in the Fraser River, creating uncertainty in assessments of species and stock composition. Because there were few DNA samples from the Whonnock test fishery, stock proportions from Area 20 test fishery samples were used to project the stock composition of sockeye migrating past the Mission hydroacoustic site. Escapement of sockeye past Mission totalled 36,000 fish by July 14, including 33,800 Early Stuart and 2,100 Early Summer-run fish, primarily from Chilliwack Lake. Environmental conditions within the Fraser River remained poor. Staff recommended the Early Stuart abundance be reduced from the pre-season forecast of 84,000 to 70,000 fish, and indicated that marine arrival timing was three to four days later than expected. Continued elevated river temperatures caused Staff to recommend an increased MA factor of 2.47 (equivalent to a DBE of -71%). Because there were no fishery implications, the Panel deferred acting on the recommendations until additional data became available.

The week of July 16 – 22 saw a slow increase in sockeye migration via Juan de Fuca Strait with little increase in the Johnstone Strait migration, suggesting a low Johnstone Strait diversion rate. Catches in Fraser River test fisheries continued to be adversely affected by seal predation, so Area 20 samples were used to project stock proportions for escapement past Mission. Mission hydroacoustic estimates showed small daily migrations, with a total through July 21 of 51,300 Early Stuart, 10,200 Early Summer, 400 Summer and 200 Harrison sockeye. Average weight data (2.1 kg, 5.3 lb) indicated that age 4_2 Fraser sockeye were about 0.2 kg (0.5 lb) smaller than average. The Panel adopted an operational abundance estimate of 70,000 Early Stuart sockeye with an Area 20 timing of July 7 and MA factor of 2.47. Staff noted that the Early Summer-run complex was tracking seven days late if the median or 50 p forecast level was true, but it was still too early in the run to recommend a change. However, Staff recommended and the Panel adopted an increased MA factor of 0.7140 for the total Early Summer run (equivalent to a DBE of -42%).

During the week of July 23 – 29, sockeye migration through Juan de Fuca Strait was building while migration via Johnstone Strait remained low. The migration profiles and DNA results indicated that both the early-timed component of the Early Summer run and the Quesnel stock group were either very weak or very late. Mission escapement through July 27 totalled 60,100 Early Stuart, 32,200 Early Summer, 9,600 Summer, 300 Birkenhead and 1,800 Harrison River sockeye. Fraser River discharge levels remained very low while the water temperature was 3°C above normal. High impact fisheries remained closed because marine abundances and river escapements of Early Summer and Summer-run sockeye were tracking well below expectations. However, on July 27 the Panel approved a low impact Treaty Indian driftnet fishery for Areas 4B, 5 and 6C.

During the week of July 30 – August 5, the estimated weekly diversion rate through Johnstone Strait was less than 30%. DNA samples from marine test fisheries showed high proportions of Seymour/Scotch and Chilko stocks, while Quesnel proportions continued to track well below expectations. Test fishing catches were increasing in the Fraser River, providing improved sample sizes for in-river DNA assessments. Significant proportions of Late Shuswap sockeye were present in Cottonwood test fishery catches, indicating the early upstream migration of Late-run sockeye had begun. Mission escapements by the end of the week totalled 66,700 Early Stuart, 188,900 Early Summer, 120,200 Summer, 700 Birkenhead sockeye and 36,500 Late-run sockeye. The reported catch to date was 7,500 fish in the United States Treaty Indian fishery in Areas 4B, 5 and 6C, 34,200 fish in Canadian marine and in-river First Nations fisheries, and 22,600 fish in Panel approved test fisheries. Staff did not recommend a change from the pre-season run-size forecast of 1.3 million for Early Summer stocks due to uncertainty about migration timing. Late Stuart, Stellako and Chilko sockeye returns were tracking below expectations, but it was too early to update the Summer-run abundance estimate. With respect to Fraser River environmental conditions, discharge in the Fraser River had dropped to 2,800 m^3/s, while the water temperature was 18.5°C. Although abundances of Early Summer and Summer-run sockeye past Mission and through marine approaches were below expectations, they were sufficiently abundant to support limited harvest of both timing groups. Early in the week, Canada announced assessment fisheries in Area D (10 boats) and Area G (8 boats), based on the improved migration via Johnstone Strait, and the Panel approved an Area E assessment fishery (2 boats). Later in the week, the Panel approved United States fisheries in Areas 4B, 5, 6C for Treaty Indian fishers and

in Areas 7 and 7A for both Treaty Indian and Non-Indian fishers. Canadian Panel Area fisheries were approved for troll fishers in Area 18 and Areas 123 and 124. Canada also announced non-Panel fisheries for Area D gillnets, Area G trollers, Area H trollers, marine and in-river First Nations FSC fisheries and recreational fisheries. Higher impact fisheries were delayed due to the late return timing and lower than expected abundances of Fraser sockeye.

During the week of August 6 – 12, inconsistencies between marine assessment data and Mission escapement estimates made it difficult for Staff to assess the incoming runs. Marine purse seine test fishing data generated daily migration estimates of approximately 200,000 fish per day via Juan de Fuca Strait and 100,000 fish per day via Johnstone Strait, with an implied diversion rate of 33%. However, Mission escapement estimates compared to these projections were low, suggesting either a delay of Fraser sockeye stocks in the Strait of Georgia or that incoming marine abundances were overestimated. Escapements of Early Summer and Summer-run sockeye past Mission were approximately 360,000 fish lower than projected for the past week, with escapements to date totalling 309,500 Early Summer, 250,800 Summer, 3,400 Birkenhead and 93,300 Late-run sockeye. Quesnel proportions continued to be much lower than expected in all areas, signalling extreme weakness of this stock, and an evaluation of age composition across key stocks suggested potential weakness in the overall return of age 4 sockeye. Catch estimates to date were: Canadian commercial – 345,500 fish, United States commercial – 80,200 fish, Canadian marine and in-river First Nations – 101,700 fish, and Panel approved test fisheries – 46,300 fish.

Two sets of abundance assessments were presented by Staff, one set incorporating historical marine test fishing expansion lines and the second set using marine expansion lines that were adjusted by the lower than expected Mission escapements over the past week. Staff advised the Panel that Early Summer total abundance was about 1.0 million fish and estimates of Summer and Late-run abundances were highly variable, and recommended the 75% probability level forecasts for both Summer and Late runs be used for fishery planning purposes. Staff also presented the Panel with TAC scenarios using the above assumptions. The Panel adopted the 75% probability level forecast for Summer-run sockeye (4.0 million fish) for fishery planning purposes, but stayed with the existing abundance levels for the Early Summer and Late-run groups. Fraser River discharges were at record low levels for the date (2,250 m^3/s), while river temperatures at Qualark declined to 18.0°C. The Panel adopted a decreased MA factor of 0.4875 (254,000 fish, equivalent to a DBE of -33%) for the Early Summer run. During the course of the week, the Panel approved United States fisheries in Areas 4B, 5, 6C for Treaty Indian fishers and in Areas 7 and 7A for both Treaty Indian and Non-Indian fishers; and Canadian fisheries in Area 20 (purse seine), Areas 18 and 29 (troll) and Area 29 (gillnet).

In the week of August 13 – 19, sockeye migration via Juan de Fuca Strait had declined while abundances through Johnstone Strait had increased, resulting in higher diversion rate estimates of 50-60%. The Area B purse seine catch in Johnstone Strait in particular exceeded modeled expectations (at the 75% probability level abundance), and provided some indication that Fraser sockeye were more abundant than reported the previous week. Marine DNA samples continued to show higher than expected fractions of Early Summer sockeye, extreme weakness of Quesnel sockeye, and close to expected proportions of Late Shuswap sockeye. Escapements past Mission were as follows: Early Summer – 532,700 fish, Summer –532,800 fish, Birkenhead – 5,100 fish and Late-run sockeye – 322,100 fish. Estimates of Late-run sockeye delaying in the Strait of Georgia were low (100,000 – 150,000 fish), which indicated the majority of Late-run sockeye were migrating directly into the Fraser River with little delay. Sockeye catches to date reported at the end of the week included: Canadian commercial – 1.5 million fish (including 163,000 First Nations Economic Opportunity catch in the Fraser River), United States commercial – 361,500 fish, Canadian marine and in-river First Nations FSC – 152,300 fish, and Panel approved test fisheries – 91,300 fish.

With a continued presence of Early Summer fish in marine areas and abundance estimates ranging between 1.3 and 2.4 million, Staff recommended the abundance be increased from 1.3 to 1.7 million fish. The Panel adopted the updated run size, including an Area 20 marine timing estimate of August 11 (10 days later than forecast). Summer-run estimates ranged from 1.8 to 5.8 million but, because the assessments remained highly uncertain, Staff recommended the Panel continue to use the 75% probability level forecast of 4.0 million for planning purposes, with an Area 20 date of August 16 (one week later than forecast). Staff noted that it was too early to make accurate estimates of Late-run abundance, but preliminary assessments suggested they were tracking below the 50% probability level forecast of 8.3 million fish. Fraser River discharge

continued to track record low levels for the date (2,050 m^3/s), while water temperature at Qualark was 18.4°C, approximately 1°C above normal. Based on the previously adopted MA factor for Early Summer-run sockeye, and increased spawning escapement target related to the larger adopted abundance, the numerical MA increased from 254,000 to 332,000 fish. The Panel approved United States fisheries in Areas 4B, 5, 6C for Treaty Indian fishers and in Areas 7 and 7A for both Treaty Indian and Non-Indian fishers; and Canadian fisheries in Area 20 (purse seine), Areas 18 and 29 (troll) and Area 29 (gillnet). In addition, Canada announced non-Panel fisheries in Areas 12 and 13 (purse seine, gillnet and troll).

During the week of August 20 – 26, the weekly diversion rate increased to the 70-95% range. A number of factors suggested the incoming sockeye run was weaker than previously thought: (1) escapements into the river were tracking below the number expected from marine-based projections; (2) marine DNA samples showed a decline in Early Summer and Summer-run stock proportions, which indicated earlier run timing; and (3) proportions of Birkenhead sockeye were larger than expected, which could be a signal of weakness for co-migrating Late-run stocks. Mission escapement estimates to date totalled 652,000 Early Summer, 676,000 Summer, 16,000 Birkenhead and 570,000 Late-run sockeye. Catches to date were 2.9 million fish in Canadian commercial fisheries (including 282,600 by Fraser River First Nations), 479,300 fish in United States commercial fisheries, 371,600 fish in Canadian marine and in-river First Nations FSC fisheries, and 110,300 fish in Panel approved test fisheries.

Model-based Summer-run abundance estimates ranged from 1.6 to 4.3 million fish. The Panel adopted two changes to Summer-run abundance this week – a decrease to 3.0 million on August 22 and then, following record high test fishing catches in Johnstone Strait (Area 12), an increase to 3.5 million on August 25. Staff evaluations indicated that modest numbers of Late-runs (400,000 to 633,000 fish) were delaying in the Strait of Georgia, with a significant number of Late-run fish continuing to migrate into the Fraser River with little or no delay. DNA estimates showed that Late-run sockeye comprised approximately 70% to 80% of marine samples. Based on this information, the Panel adopted a larger run size of 10.0 million Late-run fish, with an associated Area 20 50% date of August 22 (seven days later than forecast).

Because water temperatures were projected to increase, the Panel adopted larger MA factors for Early Summer (0.5162 or 351,000 fish) and Summer-run groups (0.12 or 227,000 fish). The downgraded Summer-run abundance and increased MAs prompted the Panel to cancel a number of previously scheduled fisheries. The larger Late-run abundance and corresponding spawning escapement target, in combination with the pre-season MA factor of 0.45 resulted in a Late-run MA of 1.8 million fish. The Panel approved fisheries in United States Areas 4B, 5, 6C for Treaty Indian fishers, and Areas 7 and 7A for both Treaty Indian and Non-Indian fishers; and in Canadian Area 29 (gillnet).

By the week of August 27 – September 2, concerns were arising over the abundance of fish associated with the large purse seine test fishing catches in Johnstone Strait the previous week. Week-ending Mission escapement estimates totalled 707,200 Early Summer, 762,400 Summer, 43,400 Birkenhead and 845,400 Late-run sockeye. Catches to date were 3.3 million fish in Canadian commercial fisheries (including 371,500 fish caught in First Nations Economic Opportunity fisheries in the Fraser River), 589,700 fish in United States commercial fisheries, 536,900 fish in Canadian marine and in-river First Nations FSC fisheries, and 131,000 fish in Panel approved test fisheries. Staff noted the following points with respect to Early Summer and Summer-run migrations: (1) the accounted number of sockeye at Mission was below expectations; (2) the estimated contribution of Summer-run sockeye in recent DNA samples was lower than expected; and (3) purse seine test fishing catches in Area 13 suggested much lower migrations in recent days than did the Area 12 catches for comparable migration days. As a consequence, Staff recommended the adoption of reduced abundance estimates: 1.5 million for Early Summers and 2.5 million for Summers. The Panel approved only the latter recommendation. Staff reported an estimated Late-run delay in the Strait of Georgia of approximately 4.6 million fish, with the large increase compared to the last meeting due to the entrance of a large Late-run migration into the Strait of Georgia that was associated with earlier peak catches in Johnstone Strait. Staff did not recommend a change to the Late-run estimate of 10.0 million fish, but noted the run may not reach this abundance if the numbers of delaying fish in the Strait of Georgia and en route from Johnstone Strait were below expectations. The reduced Summer-run abundance and associated earlier 50% migration date resulted in a reduced MA factor of 0.04 (78,000 fish), which was adopted by the Panel. The Panel approved United States fisheries in Areas 4B, 5, 6C for Treaty

Indian fishers and in Areas 7 and 7A for both Treaty Indian and Non-Indian fishers; and in Canada an Area 29 (gillnet) fishery.

Marine test fishing catches continued to decline through the week of September 3 – 9, which suggested the Late-run return was not as strong as previous estimates. Mission escapements also continued to track below expectations based on prior marine test fishing indices. As a consequence of these factors the Panel approved the following abundance downgrades: Early Summers – 1.45 million fish (Area 20 50% date of August 9); Summers – 2.0 million fish (Area 20 50% date of August 14); and Lates – 9.2 million fish (Area 20 50% date of August 22). By the end of the week, the Panel adopted a Late-run abundance of 7.5 million fish for fishery planning purposes, with an associated Area 20 50% arrival timing of August 21, while Staff estimated that approximately 3.5 million Late-run sockeye delayed in the Strait of Georgia. Mission escapement estimates were as follows: 732,700 Early Summers, 813,300 Summers, 112,700 Birkenhead and 1.5 million Late-run sockeye. Reported catches to date were: 3.6 million fish in Canadian commercial fisheries (including 384,700 by Fraser River First Nations), 660,500 fish in United States commercial fisheries, 587,600 fish in Canadian marine and in-river First Nations FSC fisheries , and 134,600 fish in Panel approved test fisheries.

By the week of September 10 – 16, the marine sockeye migration was nearing completion, with daily abundances ranging between 5,000 to 10,000 fish. However, daily escapements at Mission were also declining, and Gulf troll test fishers reported no significant abundance of sockeye off the mouth of the Fraser River. Mission escapement to date was: 757,000 Early Summers, 824,200 Summers, 145,400 Birkenhead and 1.9 million Late-run sockeye. Reported catches to date included: 3.7 million fish in Canadian commercial fisheries (including 456,100 in First Nations Economic Opportunity fisheries), 661,400 fish in United States commercial fisheries, 629,200 fish in Canadian marine and in-river First Nations FSC fisheries, and 136,900 fish in Panel approved test fisheries.

Early Summer and Summer-run abundances were unchanged at 1.5 million and 2.0 million fish, respectively. Staff noted that Gulf troll test fishing the previous week had indicated approximately 3.0 million fish remained in the Strait of Georgia, but since that date only 600,000 Late-run fish had migrated past Mission and few fish remained in the Strait of Georgia. The resulting potential escapement shortfall of up to 2. 4 million fish would result in a lower estimate of Late-run abundance. Staff advised the Panel that the total abundance of Late-run sockeye would not reach 7.5 million and would likely end up closer to 5.0 million fish. However, since there were no fishery implications the Panel decided they would formally downgrade the run once the migration was complete.

The last in-season management meeting of the Fraser River Panel took place on September 29. Final in-season accounted abundances were reported as follows: Early Stuart – 70,000 fish, with a 50% arrival timing in Area 20 of July 7; Early Summers – 1.5 million fish, with a 50% Area 20 date of August 9; Summers – 2.0 million fish, with a 50% Area 20 date of August 14; Birkenhead – 475,000 fish; and Lates – 4.7 million fish, with a 50% Area 20 date of August 20. Final in-season escapement estimates at Mission were: Early Stuart – 67,600 fish; Early Summers – 763,500 fish; Summers – 833,800 fish; Birkenhead – 163,500 fish; and Lates – 2.0 million fish. Final in-season MA factors as adopted by the Panel were: Early Stuart – MA factor of 2.47 (-71% DBE); Early Summer – MA factor of 0.5069 and MA of 294,000 fish (-34% DBE); Summer – MA factor of 0.02 and MA of 36,000 fish (-2% DBE); and Late-run sockeye – MA factor of 0.65 and MA of 1,227,000 fish (-39% DBE). Final catches by country and user group were unchanged from the prior meeting.

September 30 in Table 2 represents the date when the Panel relinquished control of the last U.S. Panel Area (remaining portions of Area 7A). According to the revised Annex IV, Chapter 4 of the Pacific Salmon Treaty and Commission Guidance to the Panel, calculation of the TAC and international shares was to be frozen on this date.

Commercial fishing times in Canadian and U.S. fisheries that targeted Fraser River sockeye salmon are summarized in Tables 3 and 4. In Canada, no gillnet fishing was scheduled in Area 20 due to coho conservation concerns.

Table 3. Number of days when fishing occurred in Canadian commercial fisheries that targeted Fraser River sockeye salmon in 2006. Fraser River Panel control of Panel Areas was relinquished in accordance with the pre-season regulations (Appendix F): Area 20 on September 9, Areas 17 and 18 on September 30 and Area 29 on October 14.

	Panel Areas				Non-Panel Areas			
	20		29	18, 29	11-16			
Date	Purse Seine	Gillnet	Gillnet	Troll	Purse Seine	Gillnet	Troll H	Troll G
Jul.2-Jul.22								
Jul.23-Jul.29								
Jul.30-Aug.5								
Aug.6-Aug.12				6		6	7	5
Aug.13-Aug.19 [1]	2		1	1	1	4	7	
Aug.20-Aug.26	2		1		1	2	2	
Aug.27-Sep.2			1			3		
Sep.3-Sep.9								
Sep.10-Sep.16								
Sep.17-Sep.23								
Sep.24-Sep.30								
Total	4	0	3	7	2	15	16	5

1 Full fleet Area H troll fishery in Areas 18 and 29 closed August 14. The Individual Transferable Quota (ITQ) fishery remained open until August 22, although no fish were landed after the close of the full fleet fishery.

Table 4. Number of days when fishing occurred in major U.S. net fisheries in the Fraser River Panel Area in 2006. Fraser River Panel control of Panel Areas was relinquished in accordance with the pre-season regulations (Appendix F): Areas 4B, 5 and 6C on September 9, Areas 6, 7 and 7A on September 16 and the remaining portions of Area 7A (Near Point Roberts) on September 30.

	Treaty Indian		Non-Indian		
	Areas	Areas	Areas 7 and 7A		
Date	4B, 5, 6C	6, 7, 7A	Purse Seine	Gillnet	Reefnet
Jul.2-Jul.22					
Jul.23-Jul.29	2				
Jul.30-Aug.5	7				
Aug.6-Aug.12	7	4	2	2	2
Aug.13-Aug.19	7	3	3	3	3
Aug.20-Aug.26	5	2			1
Aug.27-Sep.2	7	2	1	1	1
Sep.3-Sep.9	7	2	1	1	1
Sep.10-Sep.16					
Sep.17-Sep.23					
Sep.24-Sep.30					
Total	42	13	7	7	8

IV. MANAGEMENT INFORMATION

To facilitate decision making, the Panel requires information about the abundance, timing, migration route and catch levels of Fraser sockeye by stock 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 on abundance at various points along the migration route using test fisheries, hydroacoustic facilities (Mission) and observers (Hells Gate). The locations and schedule for these Staff and DFO programs are listed in Table 5. 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 allows the total abundance of sockeye to be apportioned into component stock groups. Table 6 shows the stock resolution that was reported in 2006. These stock monitoring and stock identification data

are combined to provide stock or stock-group 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. These data are compiled and analysed by Staff and the results provided to the Panel.

Table 5. Panel-approved stock monitoring operations (test fishery, hydroacoustic, observer) conducted during the 2006 fishing season.

Area	Location	Gear	Dates	Operated by
Canadian Panel Areas				
20	Juan de Fuca Str.	Purse Seine	July 24 - September 1	PSC
20	Juan de Fuca Str.	Gillnet	June 20 - August 12	PSC
29-1 to 6	Str. of Georgia	Troll	August 5 - September 14	PSC
29-13	Fraser R. (Cottonwood)	Gillnet	July 12 - September 24	PSC
29-16	Fraser R. (Whonnock)	Gillnet	June 20 - September 28	PSC
29-16	Fraser R. (Mission)	Hydroacoustic	June 25 - September 24	PSC
	Fraser R. (Hells Gate)	Observer	July 6 - September 30	PSC
Canadian non-Panel Areas				
12	Johnstone Str.	Gillnet	July 10 - August 15	DFO
12	Johnstone Str.	Purse Seine	July 20 - September 10	DFO
13	Johnstone Str.	Purse Seine	July 20 - September 9	DFO
United States Panel Areas				
5	Juan de Fuca Str.	Gillnet	July 17 - July 26	PSC
7	San Juan Islands	Reefnet	July 19 - August 31	PSC

Table 6. Individual stocks included in the Fraser River sockeye stock groups used in 2006.

Stock Group	Component Stocks
Early Stuart	
Early Stuart	Early Stuart stocks
Early Summer	
Chilliwack	Chilliwack Lake, Dolly Varden Creek
Early Miscellaneous	Fennell, Bowron, Raft, Nahatlatch, Nadina, Gates
Seymour/Scotch	Scotch, Seymour, early Eagle, Cayenne, Upper Adams
Pitt	Pitt
Summer	
Chilko	Chilko, south end Chilko Lake
Horsefly/McKinley	Horsefly, McKinley
Mitchell/Lake Tributaries	Mitchell, Roaring, Wasko, Blue Lead
Late Stuart/Stellako	Stellako, Tachie, Middle, Pinchi, Kuzkwa
Birkenhead	
Birkenhead	Birkenhead, Big Silver
Late	
Late Shuswap/Portage	Lower Adams, Portage, Lower Shuswap, Middle Shuswap, Little Shuswap, Shuswap Lake, late Eagle
Weaver/Cultus	Weaver, Cultus
Harrison	Harrison, Widgeon

Staff also provide estimates of Management Adjustments (MAs), which are estimates of how many additional fish should be allowed to escape through the various fisheries to increase the likelihood of achieving spawning escapement targets, given historical discrepancies and current year migration timings and river conditions. These MAs are based on statistical models 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 historical differences between estimates (DBEs) to the severity of 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 tend to be higher than spawning ground estimates even when migration conditions are within normal ranges, and this tendency is also captured by the MA models. For Late-run sockeye, historical DBEs are related to the date when half the run has migrated past Mission (i.e., 50% date), which captures the effect of the early migration observed in recent years on the migration success of these stocks.

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 and culminate in a set of end-of-season estimates 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 estimates in these categories are summarized in Table 2 and discussed below.

A. Abundance

Final in-season estimates of run size adopted by the Panel totalled 8.7 million Fraser sockeye (Table 2), slightly lower than the 75% probability level forecast of 9.5 million (Appendix B). The post-season estimate (13.0 million fish) was much higher but did not reach the pre-season 50% probability level forecast (17.4 million). Deviations from the pre-season forecasts were not evenly shared among the management groups. In particular, Summer-run abundance was about one third the forecast. Most of the differences between in-season and post-season estimates were due to a negative bias in in-season Mission escapement estimates (i.e., more fish arrived on the spawning grounds than anticipated, Appendix I), with the majority of the difference concentrated in the Late-run group (see Mission Escapement section below).

B. Migration Timing and Diversion Rate

Post-season estimates of migration timing in 2006 were later than pre-season expectations for most management groups (Figure 3). Early Stuart timing in Area 20 was 4 days later, Early Summer sockeye were 9 days later, Summer-run timing was 5 days later and Late-run timing was 7 days later than expected. The Area 20 50% dates for the Harrison and Weaver/Late Shuswap components of the Late run were August 13 and August 22, respectively.

Early Stuart, Early Summer and Summer runs generally migrate directly into the Fraser river. Late-run sockeye historically delay in the Strait of Georgia, but their behaviour since 1995 has changed so they now show little or no delay, and as a consequence have been subject to high rates of en route mortality. In 2006, Harrison sockeye migrated directly upstream, with a 50% date at Mission of August 17. Although the marine timing of Weaver and Late Shuswap sockeye (August 22) was 7 days later than expected, the upstream migration was earlier (post-season Mission date of September 5 versus expected date of September 9), because of a shorter-than-expected delay of these fish in the Strait of Georgia.

The end-of-season (67%) and post-season estimates (65%) of sockeye diversion through Johnstone Strait were very close to the pre-season expectation (67%) . The in-season estimate increased from about 20% through most of July to 80% by the middle of August, and then to about 90% for the balance of the season.

C. Management Adjustments and DBEs

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., revised Mission escapement as described below minus catch above Mission) and spawning ground estimates.

Compared to pre-season forecasts and in-season estimates of %DBEs, post-season estimates were smaller in magnitude for Early Stuart sockeye, larger for Early Summer and Summer runs and similar for Late-run sockeye. The lower than expected DBE for Early Stuart occurred in spite of river temperatures that were higher than usual for the time period (Figure 5). Discharge levels were near record lows, however, which may have eased the difficulty of upstream migration. For all Fraser sockeye runs, temperatures were warmer than usual and discharge levels near to or lower than the lowest values observed since the start of the Mission hydroacoustic program in 1977.

D. Mission Escapement

The estimated number of sockeye on the spawning grounds exceeded Mission-based expectations by more than 4 million sockeye. A post-season review of the causes of these discrepancies was conducted and resulted in upward revisions to the Mission hydroacoustic estimates (Appendix I). These revisions generated a post-season estimate of total Mission escapement that was more than double the in-season estimate. The revised estimates by management group were: Early Summer – 51% larger, Summer – 70% larger, Birkenhead – 172% larger and Late run – 154% larger than the respective in-season estimates (Table 7). Post-season estimates were smaller than in-season estimates for only Early Stuart (22% lower), Chilliwack Lake (a very minor stock) and Pitt River sockeye.

Table 7. Comparison of in-season estimates of Fraser River sockeye escapement past Mission in 2006 and post-season revised estimates as described in Appendix I.

Management or Stock Group	Mission Escapement		Difference	
	In-season	Post-season	Fish	%
Early Stuart	68,000	53,000	-15,000	-22%
Early Summer				
Chilliwack	6,000	5,000	-1,000	-17%
Early Miscellaneous	146,000	265,000	119,000	82%
Seymour/Scotch	547,000	843,000	296,000	54%
Pitt	64,000	39,000	-25,000	-39%
Total	763,000	1,152,000	389,000	51%
Summer				
Chilko	441,000	727,000	286,000	65%
Quesnel	222,000	416,000	194,000	87%
Late Stuart/Stellako	171,000	277,000	106,000	62%
Total	834,000	1,420,000	586,000	70%
Birkenhead	164,000	446,000	282,000	172%
Late				
Late Shuswap/Portage	1,871,000	4,827,000	2,956,000	158%
Weaver/Cultus	83,000	215,000	132,000	159%
Harrison/Widgeon	83,000	138,000	55,000	66%
Total	2,037,000	5,180,000	3,143,000	154%
Total	3,866,000	8,251,000	4,385,000	113%

V. SALMON RUN, CATCH AND ESCAPEMENT SUMMARY

Table 8 provides an overview of run size by management group for Fraser sockeye. Included are estimates of spawning escapements, DBEs, and catches in major fisheries. Table 9 provides similar information, but with more detail on individual stock groups. Figure 6 shows total abundance by year and Figure 7 shows catch, escapement and exploitation rate by year for a historical perspective. Details of commercial catch distributions by area and gear in Canada and the U.S. are provided in Tables 10-11. Tables 1 and 2 in Appendix J show abundance, spawning escapement and catch by user group in Canadian and Washington fisheries over the last four cycle years, and a geographic breakdown of Canadian First Nations catches of Fraser sockeye. Sockeye salmon escapements for the last four years on the 2006 cycle are summarized by management group in Figure 9 and by stock in Appendix J (Table 3).

A. Sockeye Summary

Post-season estimates of total return and DBEs in Tables 8 and 9 are based on the revised Mission estimates (Appendix I). The total abundance of sockeye salmon was 13.0 million fish, of which 5.4 million fish were caught and 4.7 million fish reached the spawning grounds, leaving a DBE of 2.9 million fish (Table 8). DBEs are included as part of total abundance calculations in years when the sum of spawning escapements and catches do not fully account for the total production. In 2006, a large-scale radio telemetry program provided evidence of substantial en route losses between Mission and the spawning areas (Appendix I). Thus, most of the difference in 2006 is attributed to en route mortality. The abundance in 2006 was about 86% of the abundance in the brood year (15.1 million fish in 2002) and 75% of the median pre-season forecast of 17.4 million fish. In the previous eleven returns on this cycle line, sockeye abundance has increased from a low of 3.5 million fish in 1962, to a peak abundance of 22.0 million fish in 1990, then declined to the 10-15 million range during the last three cycle years (Figure 6).

The total catch of 5.4 million fish was about 42% of the run (Table 8). This exploitation rate is consistent with the trend towards lower exploitation rates observed since the mid 1990s (Figure 7), due to lower exploitation rates associated with Canada's rebuilding strategy and conservation concerns for Late-run sockeye and other stocks. With the DBE of 22% (2.9 million fish) the actual spawning escapement of 4.7 million fish was 36% of the run.

Of the total catch, 4.6 million fish were caught in Canada, 727,000 fish in the U.S. and 140,000 fish in test fisheries (Table 8). Included in the Canadian catch was a commercial harvest of 3.2 million fish (mostly in non-Panel Areas), First Nations catch of 1.1 million fish, recreational catch of 171,000 fish and Excess Salmon to Spawning Requirements (ESSR) catch of 7,000 fish. Washington State fishers caught 703,000 sockeye in commercial fisheries and 4,500 fish in Treaty Indian ceremonial harvest, while 20,000 Fraser sockeye were harvested in Alaska.

The total return of Early Stuart sockeye was 56,000 adults (Tables 8 and 9), or 67% of the median pre-season forecast. This total included 5,900 fish caught in Fraser River First Nations fisheries and 1,600 fish caught in test fisheries, leaving 36,000 fish for spawning and a DBE of 12,000 fish. The total exploitation rate for Early Stuart sockeye was 14%.

Early Summer returns totalled 1.8 million adult sockeye, 40% larger than the median pre-season forecast of 1.3 million fish. South Thompson stocks (Seymour and Scotch) were the largest contributors to this run. Catches of Early Summer-run sockeye totalled 809,000 fish, resulting in an overall exploitation rate of 45%. Warmer than average water temperatures during upstream migration contributed to a DBE of 617,000 fish, leaving a spawning escapement of 392,000 adults. No DBE is estimated for Pitt River sockeye because they spawn below Mission.

The abundance of Summer-run sockeye was 2.5 million adults, much lower than the pre-season forecast of 7.2 million fish. The main reason for the discrepancy was the much lower than forecast number of returning salmon in the Quesnel group (16% or 719,000 fish compared to the 4.6 million fish forecast), which was likely due to poor survival of the very small smolts that went to sea in 2004. The small smolts came from the second of two consecutive years of very large escapements in 2001 and 2002. Competition for food between members of the resulting large fry population in Quesnel Lake may have resulted in slower growth rates and smaller body sizes, and likely resulted in higher mortality rates. Summer-run catches totalled 1.4 million fish, resulting in

an overall adult exploitation rate of 54%. The DBE totalled 337,000 sockeye and 815,000 adults were estimated to have reached the spawning grounds.

Table 8. Catch, escapement, DBE and abundance of Fraser River sockeye by management group in 2006.

	Fraser Sockeye						
	Early Stuart	Early Summer	Summer	Birken -head	Late	Total	% of Run
CANADIAN CATCH							
Panel Area	0	102,000	176,000	29,000	614,000	921,000	7%
Non-Panel Areas	0	289,000	545,000	116,000	1,375,000	2,326,000	18%
Commercial Catch	**0**	**391,000**	**721,000**	**145,000**	**1,989,000**	**3,247,000**	25%
Marine FSC	0	33,000	57,000	15,000	192,000	298,000	2%
Fraser River FSC	5,900	79,000	185,000	1,100	121,000	393,000	3%
Economic Opportunity	0	102,000	130,000	5,700	218,000	455,000	4%
First Nations Catch	**5,900**	**215,000**	**372,000**	**22,000**	**531,000**	**1,146,000**	9%
Marine Recreational	30	3,900	5,300	2,900	25,000	37,000	0%
Fraser Recreational	0	34,000	42,000	0	58,000	134,000	1%
Charter	20	200	200	10	200	600	0%
ESSR	0	0	0	0	6,900	6,900	0%
Non-commercial Catch	**100**	**38,000**	**48,000**	**2,900**	**90,000**	**179,000**	1%
Canadian Total	**6,000**	**644,000**	**1,141,000**	**170,000**	**2,611,000**	**4,572,000**	35%
UNITED STATES CATCH							
Treaty Indian	0	86,000	128,000	11,000	262,000	487,000	4%
Non-Indian	0	42,000	52,000	3,700	119,000	216,000	2%
Commercial catch	**0**	**128,000**	**180,000**	**15,000**	**380,000**	**703,000**	5%
Ceremonial	0	1,500	1,400	100	1,500	4,500	0%
Recreational	0	0	0	0	0	0	0%
Non-commercial Catch	**0**	**1,500**	**1,400**	**100**	**1,500**	**4,500**	0%
Washington Total	0	129,000	181,000	15,000	382,000	708,000	5%
Alaska	0	2,800	3,800	1,000	12,000	20,000	0%
United States Total	**0**	**132,000**	**185,000**	**16,000**	**394,000**	**727,000**	6%
TEST FISHING CATCH							
Canada	1,300	19,000	18,000	1,300	23,000	63,000	0%
United States	200	3,700	2,900	100	2,400	9,400	0%
Commission (Panel Areas)	1,500	23,000	21,000	1,400	25,000	72,000	1%
Canada (non-Panel Areas)	100	11,000	12,000	3,500	41,000	68,000	1%
Test Fishing Total	**1,600**	**33,000**	**33,000**	**4,900**	**67,000**	**140,000**	1%
TOTAL CATCH, ESCAPEMENT, DBEs AND RUN							
Total Catch in All Fisheries	7,600	809,000	1,359,000	191,000	3,072,000	5,439,000	42%
Adult Spawning Escapement	36,000	392,000	815,000	290,000	3,129,000	4,661,000	36%
Jack Spawning Escapement	0	200	600	100	800	1,700	0%
Differences Between Estimates	12,000	617,000	337,000	154,000	1,757,000	2,879,000	22%
Total Abundance	**56,000**	**1,819,000**	**2,513,000**	**635,000**	**7,959,000**	**12,981,000**	100%
Gross Escapement	54,000	1,225,000	1,510,000	451,000	5,291,000	8,531,000	
Total Catch in All Fisheries	14%	45%	54%	30%	39%	42%	
Spawning Escapement	64%	22%	32%	46%	39%	36%	
Differences between Estimates	22%	34%	13%	24%	22%	22%	
Total Abundance	100%	100%	100%	100%	100%	100%	

Table 9. Catch, escapement, DBE, abundance and exploitation rate for Fraser River sockeye by management and stock group in 2006.

Stock Group	Catch	Spawning Escapement	Difference Between Estimates	Abundance			Portion of Run	Adult Exploitation Rate
				Adult	Jacks	Total		
Early Stuart	7,600	36,000	12,000	56,000	0	56,000	0%	14%
Early Summer-run								
Chilliwack	1,300	1,100	3,600	6,000	0	6,000	0%	22%
Early Miscellaneous	135,000	60,000	174,000	369,000	200	369,000	3%	37%
Seymour/Scotch	643,000	292,000	439,000	1,374,000	0	1,374,000	11%	47%
Pitt	30,000	39,000	0	69,000	0	69,000	1%	43%
Total	809,000	392,000	617,000	1,818,000	200	1,819,000	14%	44%
Summer-run								
Chilko	691,000	469,000	115,000	1,275,000	600	1,276,000	10%	54%
Quesnel	365,000	170,000	184,000	719,000	0	719,000	6%	51%
Late Stuart/Stellako	303,000	177,000	38,000	518,000	0	518,000	4%	58%
Total	1,359,000	815,000	337,000	2,512,000	600	2,513,000	19%	54%
Birkenhead	191,000	290,000	154,000	635,000	100	635,000	5%	30%
Late-run								
Late Shuswap/Portage	2,922,000	2,917,000	1,625,000	7,464,000	0	7,464,000	57%	39%
Weaver/Cultus	78,000 *1*	44,000 *2*	164,000	286,000	0	286,000	2%	27%
Harrison	71,000	168,000	-31,400	208,000	800	209,000	2%	34%
Total	3,072,000	3,129,000	1,757,000	7,958,000	800	7,959,000	61%	39%
Total Adults	5,439,000	4,661,000	2,879,000	12,979,000	1,700	12,981,000	100%	42%
Total Jacks	0 *3*	1,700	0	1,700				
Total	5,439,000	4,663,000	2,879,000	12,981,000				
Portion of Total Run	42%	36%	22%	100%				

1 Catch of Weaver Creek sockeye includes an ESSR catch of 6,884 sockeye.
2 Spawing escapement estimate of Cultus sockeye includes 276 individuals captured as brood stock.
3 Jack ratio's were not estimated for fisheries; estimates include only those jacks that were actually sampled and are therefore underestimates.

Table 10. Canadian commercial catches of Fraser River sockeye salmon by gear type, license designation and statistical area during the 2006 fishing season.

Areas	Purse Seine		Gillnet			Troll			Total
	Area A	Area B	Area C	Area D	Area E	Area F	Area G	Area H	
1-10	0		0			0			0
11-16		1,493,000		491,000	24,000		82,000	223,000	2,313,000
121-127		0		0			96,000		96,000
20		54,000			0		0		54,000
17, 18, 29		0			784,000			0	784,000
Total Catch	0	1,547,000	0	491,000	808,000	0	178,000	223,000	3,247,000

For Birkenhead sockeye, the catch, escapement and DBE estimates were 191,000 fish, 290,000 fish and 154,000 fish, respectively, for a total abundance of 635,000 adults. This abundance was slightly larger than the median pre-season forecast of 562,000 fish.

The estimated return of 8.0 million Late-run adults was slightly below the median pre-season forecast of 8.3 million fish, with the Late Shuswap/Portage group the largest component. Commercial, test, and miscellaneous catches of Late-run stocks totalled 3.1 million fish, representing an exploitation rate of 39%. En route mortality related to early migration was less

severe than in most recent years for Late Shuswap/Portage stocks (DBE of 1.6 million fish, -36%). Although Weaver/Cultus sockeye experienced a large DBE of 164,000 fish (-79%) compared to the potential escapement of 207,000, the resulting spawning escapement of 44,000 fish was within the range observed in recent years. As in 2005, the spawning escapement of Harrison sockeye exceeded the estimated escapement past Mission by a significant amount.

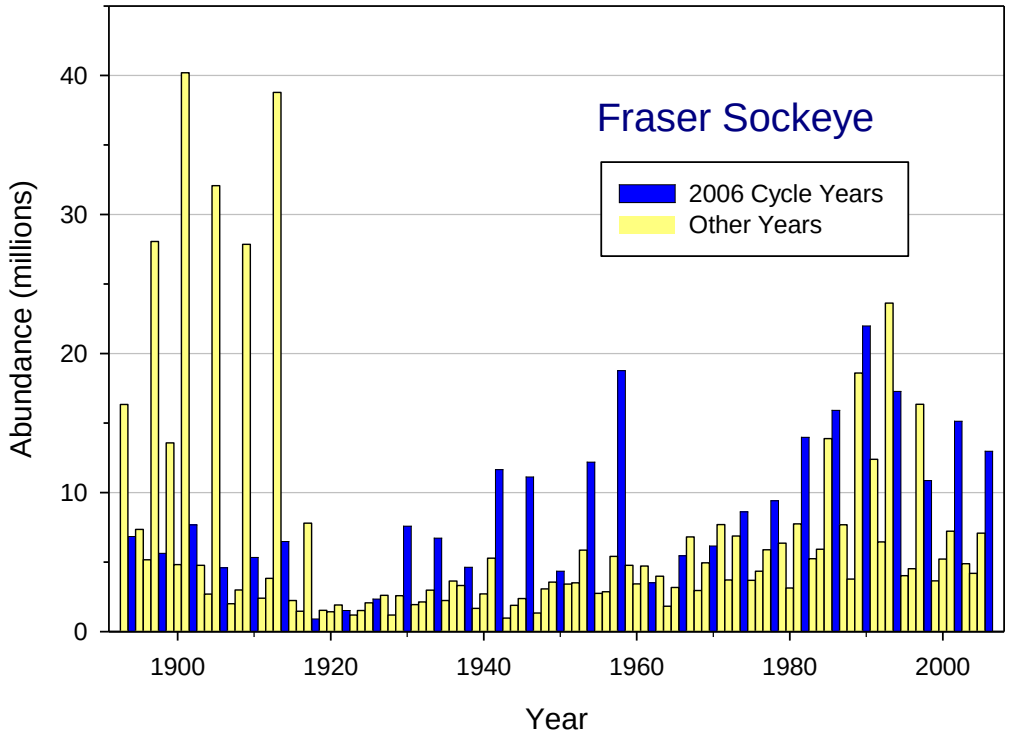

Figure 6. Total abundances of Fraser River sockeye salmon between 1893-2006. Returns on the 2006 cycle are emphasized.

Table 11. U.S. commercial catches of Fraser River sockeye salmon by user group, gear type and statistical area during the 2006 fishing season. *

Areas	Troll	Purse Seine	Gillnet	Reefnet	Total
Treaty Indian					
4B, 5 and 6C	0	0	23,000	0	23,000
6 and 7	0	158,000	54,000	0	211,000
7A	0	70,000	182,000	0	252,000
Total Catch	0	228,000	259,000	0	487,000
Non-Indian					
7	0	56,000	28,000	40,000	124,000
7A	0	50,000	42,000	0	92,000
Total Catch	0	107,000	69,000	40,000	216,000
United States					
Panel Area Total	0	334,000	329,000	40,000	703,000
Alaska (District 104) Catch					20,000
Total Catch					723,000

* Washington catches from Washington Department of Fish and Wildlife "soft system".

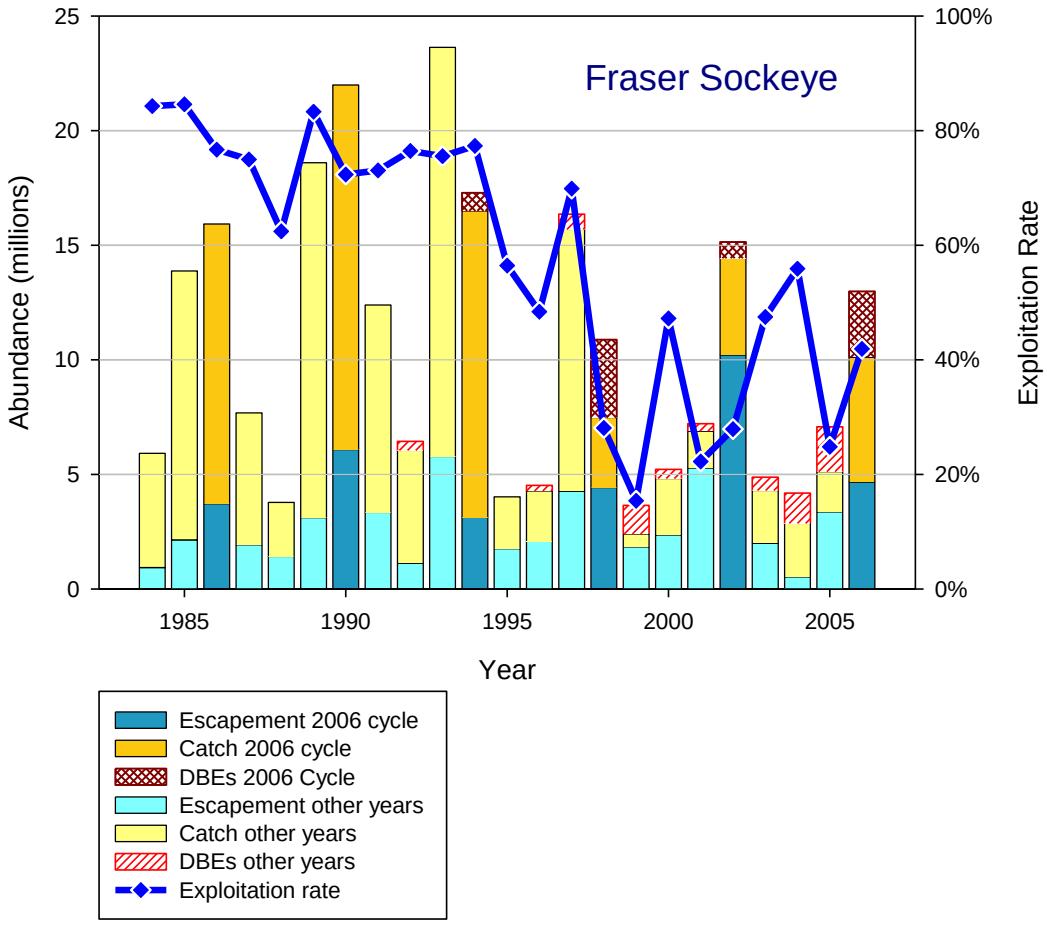

Figure 7. Total abundance, catch, escapement, DBEs, and exploitation rate (on right hand axis) for Fraser River sockeye salmon between 1984-2006, with returns on the 2006 cycle emphasized.

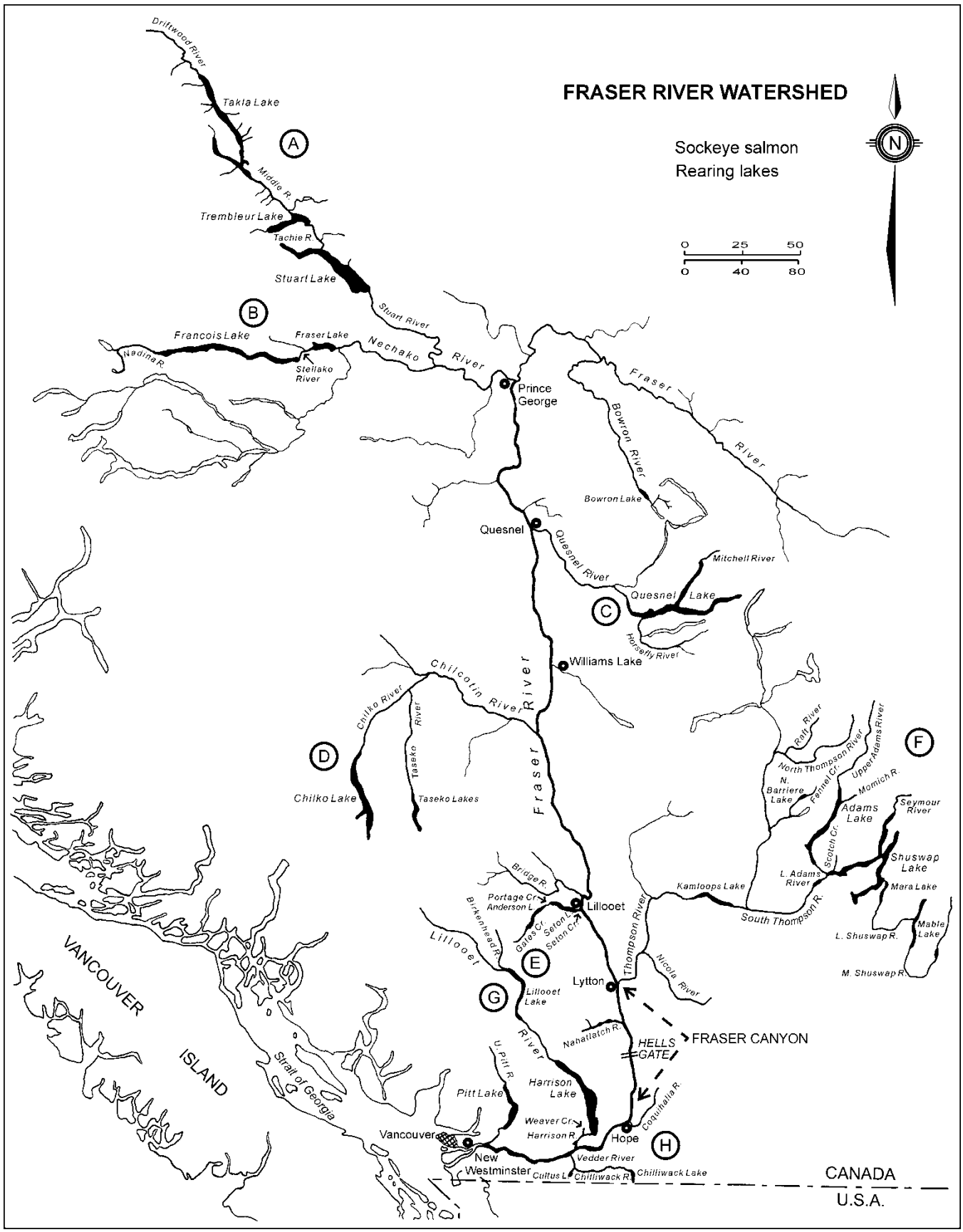

Figure 8. Sockeye salmon spawning grounds in the Fraser River watershed.

B. Spawning Escapement

Sockeye spawning escapements to the Fraser River watershed (Figure 8) are enumerated annually by DFO. These estimates are used by Staff to assess whether spawning escapement targets have been achieved and to generate final estimates of total abundance. Spawning escapement estimates are essential for post-season reporting and are an important constituent of historical data used to forecast future abundances. Data collected on the spawning grounds (e.g., scales, otoliths, tissue, length, sex) are used to partition returns by age, provide information on freshwater and marine growth, and assist in post-season evaluations of in-season stock identification and stock monitoring programs conducted by PSC staff.

In 2006, the near final estimate of adult sockeye escapement (primarily age 4 and age 5 fish) totalled 4.7 million fish. The 2006 escapement was 54% less than the brood year (2002) escapement of 10.2 million adult sockeye. Reductions in escapement relative to the brood year were primarily limited to Summer and Late-run stocks (Figure 9), and predominantly associated with Quesnel and Late Shuswap sockeye populations. In contrast, the escapement of Early Stuart sockeye was slightly higher than in the brood year, and the escapement of Harrison River sockeye was more than four times higher than the brood year escapement of 42,000 fish.

Spawning ground enumeration in the Quesnel system was incomplete in 2006. Only 23 of the 86 sockeye spawning populations typically enumerated by DFO were enumerated in 2006. However, based on the relative contributions of Quesnel sub-populations in previous cycle years, nearly 100% of the total Quesnel escapement was likely accounted for in 2006. The enumerated escapement to the Quesnel system totalled 169,800 fish, which represents only 6% of the brood year escapement of 3.1 million fish and is far below pre-season forecasts. Virtually all of the enumerated populations within the Quesnel system experienced significant reductions in spawning escapement, with Horsefly and Mitchell Rivers exhibiting the most dramatic declines. The 22,400 fish that escaped to Mitchell River in 2006 represented only 2% of the record brood year escapement of 999,000 fish, and just 6% of the recent cycle year average. A direct comparison with brood year escapement is not possible for the Horsefly River, since sockeye escapement to this system was not assessed in 2002. However, the enumerated escapement of 110,400 fish to the Horsefly River in 2006 is well below the projected brood year escapement of 2.3 million fish.

In comparison to previous escapements on this cycle line (Figure 9), the 2006 escapement is: (1) the highest escapement to the Early Stuart system since 1990; (2) the third largest since at least 1938 for Early Summer sockeye; (3) the lowest Summer-run escapement since 1986; (4) third highest Birkenhead escapement since at least 1938; and (5) the fourth largest escapement of Late-run sockeye since at least 1938 and slightly larger than the recent cycle year average (1986-2002).

The timing of peak spawning activity was consistent with historical observations for all run-timing groups. Due to the lack of late summer and early autumn precipitation, however, water levels were very low in several tributaries that have traditionally been utilized by various Summer and Late-run spawning populations. Consequently, spawner access to several tributaries within the Quesnel and Shuswap systems was restricted.

Overall spawning success of adult female sockeye within the Fraser watershed was 84%, which was lower than the 96% success rate observed in the brood year. The overall effective female spawning population in 2006 totalled 2.1 million fish, which was about 52% of the effective female population in the Fraser River watershed in 2002.

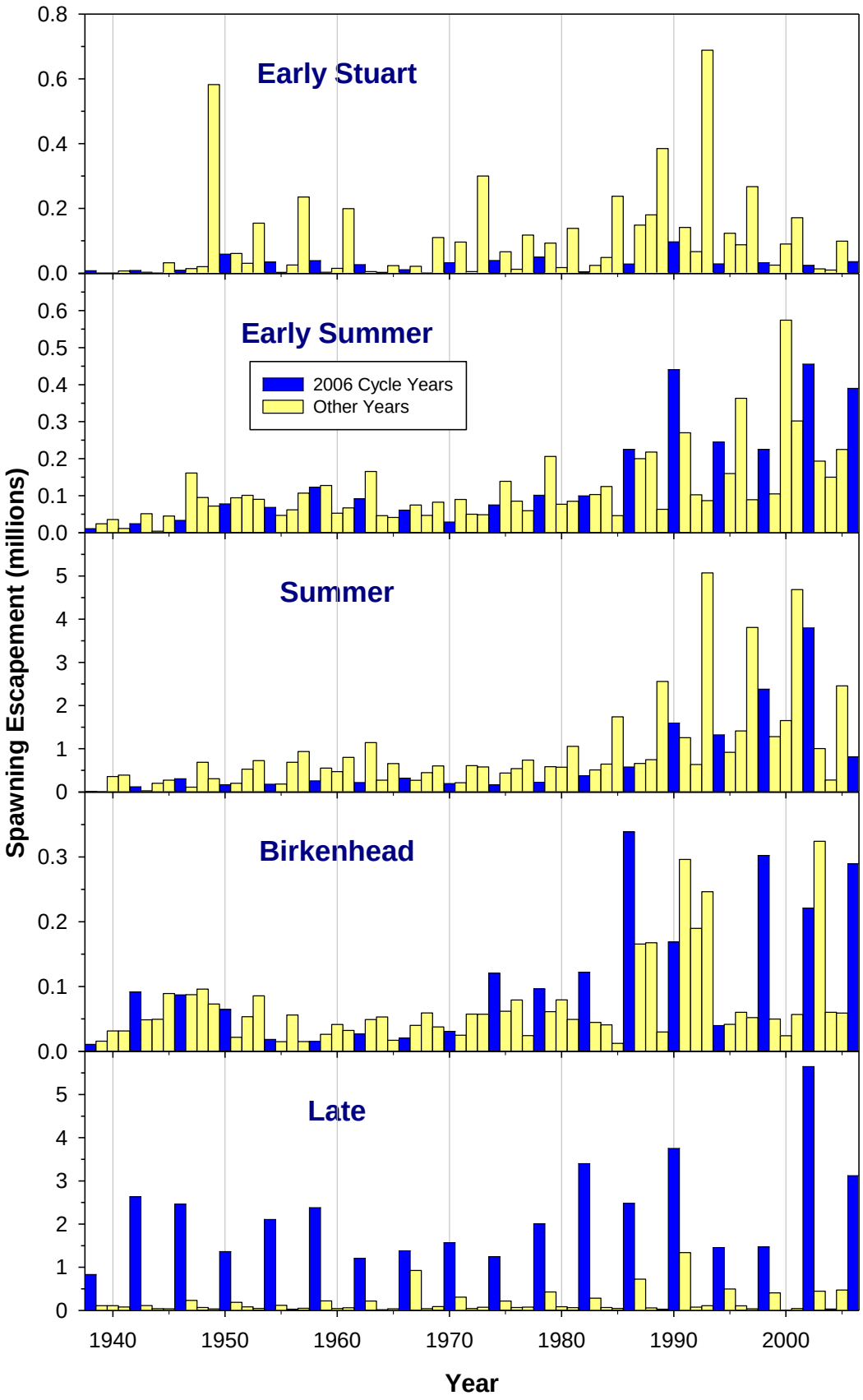

Figure 9. Adult spawning escapement of Fraser River sockeye salmon spawning by year for each management group, with escapements on the 2006 cycle emphasized.

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 annual 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 or modified by Panel agreement; (2) achieve targets for international sharing of the TAC as defined in the Treaty or by agreement among the Parties; and (3) achieve domestic catch allocation goals within each country. In the process of achieving these objectives, when planning and conducting fisheries the Panel must consider conservation concerns for other stocks and species of salmon. 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.

A. Escapement

The Panel's first task is to achieve spawning escapement targets as specified by Canada. Spawning escapement targets for Early Stuart, Early Summer, Summer and Late-run sockeye were determined by applying Canada's spawning escapement plan to abundance estimates for each management group. The objective (as a percentage of abundance) established for Summer-run sockeye was also applied to Birkenhead sockeye.

In-season management is based on targets for potential spawning escapement (PSE), which include spawning escapement targets plus MAs. This is partly because the Panel's mandate extends only to commercial fisheries, which have an upriver boundary at Mission, BC, in the lower Fraser River. Furthermore, direct in-season monitoring of the progress toward spawning escapement targets is infeasible because of the large time lag between management actions and salmon arriving on the spawning grounds. Estimates of Mission escapement and catch above Mission, however, are available in-season. Based on final in-season PSE estimates (i.e., Mission escapement minus First Nations and recreational catches above Mission), in-season PSE targets were exceeded for Early Stuart (7% over) and Early Summer (5% over) sockeye, but not achieved for Summer (44% under), Birkenhead (13% under) and Late-run sockeye (24% under) (Table 12).

Table 12. Comparison of in-season potential spawning escapement (PSE) targets at the time the Panel relinquished control of the last U.S. Panel Area (September 30) and in-season PSE estimates, for Fraser River sockeye salmon in 2006.

	Potential Spawning Escapement					
Management Group	Spawning Escapement Target	Management Adjustment	Adjusted Target	In-season Estimate	Difference Fish	Difference %
Early Stuart	68,500	0	68,500	73,000	4,500	7%
Early Summer	580,000	294,000	874,000	920,000	46,000	5%
Summer	1,792,000	36,000	1,828,000	1,031,000	-797,000	-44%
Birkenhead	190,000	0	190,000	165,000	-25,000	-13%
Late	1,888,000	1,227,000	3,115,000	2,365,000	-750,000	-24%
Adult sockeye	4,518,500	1,557,000	6,075,500	4,554,000	-1,521,500	-25%

These results show that the Panel had mixed success in delivering fish into the river in the form of potential spawning escapements as measured at the end of the season. Success was achieved for the earliest runs, but for Summer and Late runs the shortfalls in in-season PSEs were largely due to late-season reductions in abundance estimates that occurred after fisheries that targeted these fish were complete. For example, the Summer-run estimate was reduced from a high of about 4.0 million fish in the middle of August down to 2.0 million fish in early September in a series of weekly downgrades (Table 2). Similarly, Late-run abundance estimates were reduced from a high of 10.0 million fish in early September to less than 5.0 million by the beginning of October. The overall result was that more Summer and Late-run fish were caught in marine and lower river fisheries than would likely have been caught if in-season assessments had declined in time to affect fishery decisions.

Spawning escapements were well below the post-season spawning escapement targets for Early Stuart, Early Summer and Summer runs but met or exceeded the targets for the later-timed groups. Total spawning escapements of Fraser sockeye were 24% below the overall target (Table 13).

Table 13. Comparison of post-season spawning escapement targets and upriver escapement estimates for adult Fraser River sockeye salmon in 2006.

	Spawning Escapement			
Management	Post-season	Upriver	Difference	
Group	Target	Estimate	Fish	%
Early Stuart	54,000	36,000	-18,000	-33%
Early Summer	728,000	392,000	-336,000	-46%
Summer	1,947,000	815,000	-1,132,000	-58%
Birkenhead	254,000	290,000	36,000	14%
Late	3,184,000	3,129,000	-55,000	-2%
Adult sockeye	6,166,000	4,661,000	-1,505,000	-24%

For Early Stuart, the spawning escapement target was effectively the entire run less an allowance for test fishing catches used to assess abundance. Thus, any catch or en route loss resulted in an escapement below the target level. The spawning ground shortfall is explained by the combination of 6,000 fish caught in Fraser River First Nations fisheries and a DBE of 12,000 fish (Table 8).

Early Summer and Summer-run spawning escapements were substantially less than the post-season targets. The reasons for this were threefold. Firstly, post-season catch targets were exceeded because run-size estimates declined after fisheries based on larger run sizes and TACs were complete. In other words, the available harvest decreased after the catch was already landed. Secondly, the observed differences between estimates of spawning escapement and potential spawning escapement (based on revised Mission escapements) for Early Summer and Summer sockeye were much larger than predicted by the in-season MA models. Predicted DBEs for these groups were -34% and -2%, respectively, compared to observed differences of -61% and -29%. Thus, the number of fish that passed Mission and subsequently were enumerated on the spawning grounds was fewer than predicted. Finally, even if no catch had been taken, the run sizes were too small to achieve the spawning escapement targets given the observed DBE rates. While all three components contributed to the escapement shortfalls, the main component responsible for the Early Summer shortfall was the higher than predicted DBE rates, while for Summer-run sockeye it was the reductions in run size and available harvest after the catch had been taken.

The spawning escapement target for Birkenhead was exceeded by 14%, while the late-run target was essentially achieved (only 1% under).

B. International Allocation

The Panel's second priority is to achieve the goals for international allocation of the TAC. In accordance with the February 17, 2005, Panel agreement, the TAC calculation is based on the run size and deductions that were available on September 30, when control of the last U.S. Panel Area was relinquished.

With the total abundance estimate of 8.7 million Fraser sockeye, minus deductions for spawning escapement, MA, test fishing catch and Fraser River Aboriginal Fishery Exemption (AFE), the TAC in 2006 was about 2.3 million sockeye (Table 14 and Appendix J, Table 4). Because for Early Stuart and Summer-run sockeye the TAC deductions exceeded the run sizes, the TACs for these management groups were set to zero. The TACs for all management groups were then summed to obtain the total sockeye TAC for international sharing noted above. There were no paybacks to carry forward from 2005, so the U.S. share in Panel Areas (Washington) was 16.5% of the TAC or 373,000 fish. The actual catch (708,000 sockeye) exceeded the U.S. share by 335,000 sockeye. The Canadian share was the balance of the TAC (1.9 million fish) plus the Aboriginal Fishery Exemption of 400,000 sockeye. Canadian fishers caught 4.6 million sockeye, resulting in 2.3 million sockeye being caught in excess of the Canadian share.

Table 14. Total allowable catch and international catch allocation for Fraser River sockeye salmon in 2006. In-season estimates of abundance, spawning escapement target, management adjustment and test fishing catch at the time the Panel relinquished control of the last U.S. Panel Area (September 30) were used, according to the revised Annex IV agreed to on Feb. 17, 2005.

			Sockeye
TOTAL ALLOWABLE CATCH			
In-season Total Run Size			8,715,000
Deductions			
In-season Spawning Escapement Target		1	4,518,500
In-season Management Adjustment		1	1,557,000
Aboriginal Fishery Exemption			400,000
In-season Test Fishing Catch			134,500
	Total Deductions:		6,610,000
	Total Allowable Catch:	2	2,258,000
UNITED STATES			
Washington Share			
Washington Share of TAC		3	373,000
Payback			0
	Total Share:		373,000
Washington Catch			708,000
	Deviation:		-335,000
In-season Alaska Catch Estimate			0
CANADA			
Canadian Share + Aboriginal Fishery Exemption			2,285,000
Canadian Catch excluding ESSR Catch			4,565,000
	Deviation:		-2,280,000

1 By Panel agreement (Feb. 17, 2005), the TAC calculation was fixed on the date the Panel relinquished control of the last U.S. Panel Area (Sept. 30). This means the run size, spawning escapement target, management adjustment, Aboriginal Fishery Exemption and test fishing deduction were frozen on this date.

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 is shown in Appendix J..

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

C. Domestic Allocation

The third priority of the Panel is to achieve domestic allocation goals as specified by the Parties. While the Panel manages all commercial fisheries directed at Fraser River sockeye and pink salmon in Panel Area waters (Figure 1), Canada has sole responsibility for regulating 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. Thus, achievement of Canadian domestic allocation goals requires coordination between Panel and non-Panel regulatory actions.

With respect to domestic allocations of Fraser sockeye, Treaty Indian fishers in Washington caught 13,000 fish above their share of 479,000 fish, while Non-Indian fishers caught 13,000 fish below the share of 229,000 fish (Table 15). In Canada, Area B purse seines were 5,000 fish over, Area D gillnets were 110,000 fish under, Area E gillnets were 94,000 fish over, Area G trollers were 32,000 fish over and Area H trollers were 21,000 fish under their respective allocations (Table 16).

Table 15. Domestic overages and underages in Washington catches of Fraser River sockeye salmon in 2006.

User Category	Actual Catch Fish	Actual Catch %	Catch Goals Fish	Catch Goals %	Deviation
Treaty Indian *	492,000	69.5%	479,000	67.7%	13,000
Non-Indian **	216,000	30.5%	229,000	32.3%	-13,000
Washington Total:	708,000	100.0%	708,000	100.0%	0

* Treaty Indian catch includeds commercial and ceremonial catches.

** Non-Indian catch includes commercial and recreational catches.

Table 16. Domestic overages and underages in Canadian commercial catches of Fraser River sockeye salmon in 2006.

Gear License Area	Actual Catch Fish	Actual Catch %	Catch Goals Fish	Catch Goals %	Deviation
Purse Seine					
A Northern	0	0.0%	0	0.0%	0
B Southern	1,547,000	47.6%	1,542,000	47.5%	5,000
Total	1,547,000	47.6%	1,542,000	47.5%	5,000
Gillnet					
D Johnstone Strait	491,000	15.1%	601,000	18.5%	-110,000
E Fraser River	808,000	24.9%	714,000	22.0%	94,000
Total	1,299,000	40.0%	1,315,000	40.5%	-16,000
Troll					
F Northern	0	0.0%	0	0.0%	0
G Southern	178,000	5.5%	146,000	4.5%	32,000
H Inside	223,000	6.9%	244,000	7.5%	-21,000
Total	401,000	12.3%	390,000	12.0%	11,000
Total	3,247,000	100.0%	3,247,000	100.0%	0

D. Conservation of Other Stocks and Species

Catches of non-target stocks and species in Panel Area fisheries directed at Fraser River sockeye salmon were small (Table 17). By-catches of non-Fraser salmon in commercial net fisheries regulated by the Fraser River Panel totalled 350 sockeye and 1,000 pink salmon in 2006. Catches of other Fraser and non-Fraser salmon included 8,900 chinook, 1,600 coho, 460 chum and 40 steelhead.

Table 17. Catches of non-Fraser sockeye and pink salmon and of other salmon species in commercial fisheries regulated by the Fraser River Panel in 2006.

Area and Gear	Non-Fraser		Fraser and Non-Fraser			
	Sockeye	Pink	Chinook	Coho	Chum	Steelhead
United States *						
Areas 4B, 5 and 6C Net	350	380	800	1,400	160	40
Areas 6, 7 and 7A Net	0	390	4,700	150	80	0
Total	350	770	5,500	1,550	240	40
Canada **						
Area 20 Net	0	0	0	0	10	0
Area 29 Net	0	250	3,400	0	210	0
Total	0	250	3,400	0	220	0
Total	350	1,020	8,900	1,550	460	40

* Estimates are from the WDFW "soft-system".

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

VII. ALLOCATION STATUS

In accordance with Panel interpretation of the Commission Guidance (February 18, 2005), no paybacks were carried forward from 2005 to 2006 (Table 18). Also, by Panel agreement (February 14, 2008), no paybacks were generated from excess catches in 2006, so there are no paybacks to carry forward to future years.

Table 18. Allocation status of Fraser River sockeye and pink salmon for 1999-2006.

Year	1999	2000	2001	2002	2003	2004	2005	2006
Sockeye Salmon								
TOTAL ALLOWABLE CATCH								
Total Abundance	3,643,000	5,217,000	7,213,000	15,312,000	5,408,000	4,438,000	8,770,000	8,715,000
Escapement and other deductions	3,438,000	3,198,000	6,132,000	9,568,000	3,159,000	3,663,000	6,124,000	6,457,000
Total Allowable Catch:	205,000	2,019,000	1,081,000	5,744,000	2,249,000	775,000	2,646,000	2,258,000
UNITED STATES								
Washington Catch	20,000	494,000	241,000	449,000	244,000	197,000	201,000	708,000
Washington Share (exclds payback)	46,000	412,000	241,000	496,000	371,000	128,000	437,000	373,000
Deviation:	-26,000	82,000	0	-47,000	-127,000	69,000	-236,000	335,000
Cumulative Allocation Status:	-26,000	56,000	56,000	9,000	0 **	0 **	0 **	0 **
Pink Salmon								
TOTAL ALLOWABLE CATCH								
Total Abundance	3,616,000		21,293,000		26,000,000		10,000,000	
Escapement and other deductions	3,468,000		19,881,000		7,843,000		6,010,000	
Total Allowable Catch:	148,000		1,412,000		18,157,000		3,990,000	
UNITED STATES								
Washington Catch	17,000		445,000		811,000		338,400	
Washington Share *	38,000		445,000		4,666,000		1,025,400	
Deviation:	-21,000		0		-3,855,000		-687,000	
Cumulative Allocation Status:	-21,000		-21,000		0 **		0 **	

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

1999: Shall not exceed 22.4% for Fraser sockeye and 25.7% for Fraser pinks.

2000: Shall not exceed 20.4% for Fraser sockeye.

2001: Washington share equals Washington catch for Fraser sockeye and pink salmon, by agreement between the Parties on June 12, 2002.

2002: By a Feb. 12-13, 2003 Panel agreement, the Washington share equals the Washington catch plus the maximum payback (449,000 + 47,000 = 496,000). By agreement, no paybacks generated for 2003.

2003: Shall not exceed 16.5% for Fraser sockeye minus the payback, and 25.7% for Fraser pinks plus the payback. By agreement, no paybacks generated for 2004.

2004: Shall not exceed 16.5% for Fraser sockeye. By agreement, no paybacks generated for 2005.

2005: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks. Panel interpretation of Feb. 18, 2005 Commission Guidance, item 1c(ii), was that no paybacks resulted from catch overages or underages in 2005 and so no paybacks generated for 2006.

2006: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks. By Panel agreement (Feb. 14, 2008), no paybacks generated for 2007.

** 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.

Difference between estimates (DBE): Difference between estimates of potential spawning escapement (PSE) and spawning escapement. Sources for DBEs include en route mortality and errors (variability) 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, where pDBE is the %DBE represented as a proportion.

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 weekly time steps or a value for the entire migration.

Economic Opportunity (EO) fishery: Commercial Fraser River First Nations fishery.

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, catch and escapement objectives, and management adjustments.

Gross Escapement

> **In-season gross escapement**: An in-season measure of gross escapement, calculated by summing the escapement past Mission plus First Nations, recreational and ESSR catches in the Fraser River below Mission.
>
> **Post-season gross escapement**: Sum of spawning ground enumerations, differences between estimates (DBEs), and catches in First Nations (FSC and EO), recreational and ESSR fisheries in the Fraser River watershed.

Management Adjustment (MA): A management adjustment is 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 a proportional adjustment (pMA) to the spawning escapement target that is likely required in the current year to achieve the target. When the pMA is multiplied by the spawning escapement target it becomes a numerical MA. 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: The groups of salmon stocks that are assessed and managed individually, i.e., Early Stuart, Early Summer, Summer, Birkenhead and Late-run groups.

Migration date or 50% date: Dates when 50% of the total run would have passed a certain geographical location, if it is assumed that all fish migrated via that route. Such dates are usually specified by management group or stock group.

> **Area 20 date**: An index of marine migration timing, assuming the entire run migrated through Canadian 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 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: 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.

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) to account for historical differences between in-season and post-season estimates of escapement (DBEs). 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 First Nations and recreational catches above Mission. If there were no en route mortalities or estimation errors in Mission escapement, up-river catch, spawning escapement or stock identification, the potential spawning escapement would in theory equal the enumerated spawning population.

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

Spawning Escapement

Spawning escapement or Net escapement: Spawning escapement of adult male and female spawners and jack (age 3) spawners as estimated through enumeration programs conducted on the spawning grounds, or projected from other data when enumerations programs are not conducted (e.g., Quesnel spawners 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 in Canada's Spawning Escapement Plan.

List of abbreviations

AFE: Aboriginal Fishery Exemption
DBE: Difference between estimates
CPUE: Catch per Unit of Effort
DFO: Fisheries and Oceans Canada
DIDSON: Dual-frequency IDentification SONar
EO: Economic Opportunity
ESSR: Terminal harvest of Weaver Creek sockeye that are "Excess Salmon to Spawning Requirements"
FRP: Fraser River Panel
FRPTC: Fraser River Panel Technical Committee
FSC: "Food, social and ceremonial", as relates to First Nations fisheries
JS: Johnstone Strait
LGL: A biological consulting company.
m^3/s: cubic meters per second
MA: Management Adjustment
MLP: Mandatory Landing Program
M-R: Mark-recapture
pMA: Proportional Management Adjustment
PSC: Pacific Salmon Commission
SET: Spawning Escapement Target
TAC: Total Allowable Catch
WDFW: Washington Department of Fish and Wildlife

APPENDIX B: 2006 PRE-SEASON FORECASTS AND SPAWNING ESCAPEMENT TARGETS FOR FRASER RIVER SOCKEYE SALMON

Table 1. Pre-season forecasts for Fraser River sockeye salmon. (Provided to the Panel by Fisheries and Oceans Canada) [1]

Sockeye stock/timing group	Forecast model [b]	Mean Run Size [c]		Probability of Achieving Specified Run Sizes [a]				
		all cycles	2006 cycle	0.1	0.25	0.5	0.75	0.9
Early Stuart	fry	**362,000**	**129,000**	**175,000**	**124,000**	**84,000**	**55,000**	**38,000**
Early Summer		**492,000**	**586,000**	**4,545,000**	**2,412,000**	**1,303,000**	**721,000**	**435,000**
Bowron	Ricker-pi	35,000	21,000	85,000	54,000	34,000	22,000	15,000
Fennell [f]	TSA	25,000	13,000	692,000	140,000	24,000	4,000	1,000
Gates [g]	power	58,000	21,000	50,000	31,000	20,000	11,000	7,000
Nadina	fry	82,000	24,000	94,000	54,000	29,000	16,000	9,000
Pitt	power	67,000	56,000	292,000	194,000	124,000	75,000	51,000
Raft	power	29,000	14,000	172,000	109,000	71,000	43,000	28,000
Scotch	R1C	49,000	119,000	567,000	319,000	168,000	89,000	50,000
Seymour	Ricker-cyc	147,000	318,000	1,039,000	656,000	393,000	253,000	166,000
Misc [d]	R/S	-	-	1,554,000	855,000	440,000	208,000	108,000
Summer		**4,669,000**	**3,943,000**	**23,240,000**	**13,052,000**	**7,158,000**	**4,020,000**	**2,484,000**
Chilko	smolt-esc	1,636,000	1,597,000	3,110,000	2,257,000	1,689,000	1,215,000	932,000
Late Stuart	R1C	686,000	305,000	2,017,000	803,000	288,000	104,000	41,000
Quesnel [h]	R1C	1,824,000	1,538,000	16,786,000	9,104,000	4,613,000	2,338,000	1,268,000
Stellako	R1C	523,000	503,000	1,327,000	888,000	568,000	363,000	243,000
Late		**3,196,000**	**8,143,000**	**28,586,000**	**16,314,000**	**8,812,000**	**4,734,000**	**2,727,000**
Cultus	smolt-jack	28,000	28,000	18,000	11,000	5,800	3,000	1,000
Harrison [i]	TSA	35,000	45,000	184,000	90,000	41,000	19,000	9,000
Late Shuswap [j]	RAC	2,206,000	6,745,000	21,605,000	12,359,000	6,644,000	3,572,000	2,043,000
Portage	Ricker	52,000	80,000	269,000	134,000	67,000	34,000	18,000
Weaver	fry	384,000	594,000	1,117,000	656,000	411,000	259,000	175,000
Birkenhead	power	491,000	651,000	1,120,000	713,000	433,000	274,000	183,000
Misc Shuswap [e]	R/S	-	-	3,819,000	2,101,000	1,081,000	512,000	266,000
Misc. non-Shuswap [e]	R/S	-	-	454,000	250,000	129,000	61,000	32,000
TOTAL		**8,719,000**	**12,801,000**	**56,546,000**	**31,902,000**	**17,357,000**	**9,530,000**	**5,684,000**

a probability that the actual run size will exceed the specified projection

b see text for model descriptions

c 1970-2004 mean

d unforecasted miscellaneous Early Summer stocks

e unforecasted miscellaneous Late stocks

f Fennell performance measures of TSA and RAC models were nearly indistinguishable. Brood effective females (4800) were nearly double the cycle line average (2680) and 25% greater than the time series average (3861). This lends weight to the choice the TSA model which forecasts double that of the RAC model.

g Gates Power model ranked third in the MAE measure, because the Fry and MRS models tied for the first rank. This influenced the average rank of the Power model. However, because the Power model is virtually the same or superior on all measures and has narrower bounds on the forecast it was the model chosen.

h Fry based models for Quesnel ranked third, with much greater RMSE (uncertainty) than the top two models. The fry model forecast was 6.2M (1.4M - 27M). Additionally, the top three models were all "naive", outperforming all escapement based models. While Quesnel escapement was near the historic maximum, productivity has been low relative to historic values - even during years of low escapement. Fry sizes are lower than average suggesting a conservative forecast would be appropriate.

i Harrison brood escapement exceeds the historical range. Use of any escapement based model would be invalid. The best ranking naïve model was chosen.

j The RAC model outperformed all fry models for Late Shuswap. Fry models still have great uncertainty because of their short time series (forecast 9M intervals ranging 3M to 39M). Brood escapement was 1.6x the historic maximum. Any escapement based forecast would be outside the predictive range of the model, making it invalid. Therefore only naive models were considered.

Model definitions: TSA (Time series average of recruitment); R1C (recruitment like last generation); RAC(Average recruitment on the cycle line); Ricker-pi (Ricker function with Pine Island SST covariate); Ricker-cyc (Ricker function using cycle line data only); Smolt-esc (multiple linear relation between smolt production, escapement, and recruitment)

[1] 2006/2007 Southern B.C. Salmon Integrated Fishery Management Plan. Fisheries and Oceans Canada.

Table 2. Fraser River sockeye salmon escapement plan (in thousands of fish) for 2006. (Provided to the Panel by Fisheries and Oceans Canada). [1]

Stock Group	Run Size Estimate	Run Size Reference Points (a)	Total Mortality Rate Guidelines	Total Mortality Target at Run Size	Escapement Target at Run Size	Management Adjustment (b)		Exploitation Rate after MA
Early Stuart	84	- 100 100 300 300	0% 0 - 60% 60%	0%	84	54%	45	0%
Early Summer	1,303	- 255 255 724 724	0% 0 - 60% 60%	60%	521	34%	179	46%
Summer	7,158	- 1,562 1,562 4,094 4,094	0% 0 - 60% 60%	60%	2,863	0%	0	60%
Birkenhead and Birkenhead-type Lates (c)	562	- 123 123 321 321	0% 0 - 60% 60%	60%	225	0%	0	60%
true-Late (excl. Birk. Type)	8,250	- 2,422 2,422 4,441 4,441	0% 0 - 60% 60%	60%	3,300	59%	1,947	36%
Sockeye Totals	17,357 *Est. Return*				6,993		2,172	

a) Reference points based on exploitation rate targets

b) 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 2006. We expect that the MAs will be revised to take into account an environmental conditions during the inseason management period.

c) Birkenhead type Lates include returns in the miscellaneous non-Shuswap component of the forecast returning to natal spawning areas in the Harrison-Lillooet systems (excluding Harrison and Weaver).

APPENDIX C: 2006 FRASER RIVER PANEL MANAGEMENT PLAN PRINCIPLES AND CONSTRAINTS (June 22, 2006)

1. Fisheries and Oceans Canada (DFO) have provided the Panel with run-size forecasts for Fraser River sockeye salmon by run timing group. For pre-season planning purposes, the Panel used the 50% probability (p) levels of abundance. There is a 50% probability that the Fraser sockeye salmon return will reach or exceed 17,357,000 fish.
2. The Panel's first priority for 2006 is to achieve Late-run sockeye[1] objectives as indicated in the document, "Guidelines for Pre-season Fraser Sockeye Fishing Plans to Address Late-Run Concerns".
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 early and a significant proportion will not survive to spawn. Unlike recent years, however, 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 18, 2005 Commission Guidance 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, while the Canadian share of the TAC is 83.5%. Based upon the 50% p levels of abundance, for the purposes of computing TAC by stock management grouping in 2006, the Panel agreed that the Fraser River Aboriginal Exemptions were as follows: Early Stuart sockeye, 0 fish, Early Summer sockeye, 45,200 fish; Summer-run sockeye, 292,500 fish; Birkenhead sockeye, 2,200 fish; and Late-run sockeye, 60,100 fish. There is no available harvest of Early Stuart sockeye at the 50% p level forecast of abundance. As per Fraser Panel agreement, for the 2006 season there are no paybacks of Fraser River sockeye due from prior years.
5. The Panel has adopted 50% probability level forecasts for Early Stuart (84,000 fish), Early Summer-run (1,303,000 fish), Summer-run (7,158,000 fish) and Late-run sockeye (8,250,000), for planning fisheries. When sufficient information is available in-season, the Panel will update run size estimates of Fraser River sockeye, as appropriate.

Regulations

i) If the abundance of Early Summer-run sockeye salmon is tracking at approximately the 50% probability level (1,303,000 fish) and the abundance of Summer-run sockeye salmon is tracking at approximately the 50% probability level (7,158,000 fish) and the runs arrive at or near normal dates, fisheries would be expected to commence the week of July 23 – 29 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 2006 management season.

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

APPENDIX D: GUIDELINES FOR PRE-SEASON FRASER SOCKEYE FISHING PLANS TO ADDRESS LATE-RUN [1] CONCERNS (June 22, 2006)

The 2006 cycle is the dominant-line cycle for Adams River sockeye. True 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. Unlike recent years, Late-run stocks behaved more normally in the brood year (2002), delaying in Georgia Strait prior to migrating upstream. As a consequence, stocks were not as severely impacted by early upstream migration and mortality, and the number of effective spawners to all stock complexes except Cultus sockeye exceeded historical averages on this cycle. The total forecast for Late-run sockeye in 2006 (8,250,000 fish at the 50% p level) is approximately the same as the average for the cycle (1973 – 2001). 2006 is also the dominant cycle line for Cultus sockeye and the forecast (5,800 fish at the 50% p level), though larger than for recent years, is still well below the average return on this cycle. Therefore, special consideration will be given to help ensure this stock's long-term viability. A co-ordinated approach to management will be developed that reflects both Parties sharing the burden of conservation of Late-run sockeye. Additional measures to reduce the fishing impact on Cultus sockeye will be taken by Canada in 2006.

ASSUMPTIONS

1. For fisheries planning purposes, we assumed that Late-run sockeye will continue their post-1995 early upstream migration behaviour. A 50% upstream migration date (past Mission) of September 9 was adopted based on historical Late-run marine timing on this cycle, and on Late-run upstream migration behaviour since 1995 on the 2006-2007 cycle lines. In addition, we assumed a difference between estimates of 31% as predicted by the Management Adjustment model using 2006-2007 cycle line data and an assumed upstream migration date of September 9. This level of difference is consistent with en route mortality estimates derived from the application of 2002 and 2003 Late-run sockeye tagging results to upstream timing assumptions in the pre-season planning model.
2. Estimates of abundance, migration timing, etc., for Summer-run and Late-run sockeye, will be provided in-season, however, the timeliness of Late-run abundance and timing updates will depend on the pattern of migration and may not occur during the period of active in-season Panel Area management. PSC staff have developed models to predict the in-river migration timing and associated en route mortality rate of Late-run sockeye and will advise the Panel if changes to pre-season assumptions are warranted. Staff will not be able to provide stock-specific assessments for Cultus sockeye due to their low forecast abundance 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.
3. In-season assessment capabilities with respect to monitoring the run strength and migration timing of Late-run stocks in 2006 provide the opportunity for a flexible approach to management based on the combination of pre-season planning and in-season information. Thus, Canada has provided an escapement plan for all stocks including the Late-run sockeye that varies exploitation rates with different levels of abundance. Escapement targets will also be modified based on Management Adjustments derived from Fraser River environmental conditions for Early Stuart, Early Summer-run and Summer-run stocks, and based on in-season estimates of upstream timing for Late-run stocks.
4. The pre-season fishing plan assumes a 6 day separation in the 50% marine migration timing (through Juan de Fuca Strait; Area 20) between Summer-run (August 9) and Late-run sockeye (August 15).

ELEMENTS OF THE PLAN

- To help ensure that Late-run conservation objectives are achieved, in-season decisions regarding fisheries directed at Summer-run sockeye will be constrained as necessary by potential harvest impacts on Late-run sockeye. Late-run sockeye catches will be estimated primarily with DNA stock identification methods.

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

APPENDIX E: 2006 FRASER PANEL MANAGEMENT PROCESS (June 18, 2006)

The purpose of this document is to ensure that the Panel and Staff have a common understanding of the key factors relating to 2006 in-season management. These factors are summarized below in point form.

1. The 2006 management plan is similar in structure to recent past years, with fishing opportunities constrained by Early Summer-run sockeye early in the management season, and by conservation concerns for Late-run[1] stocks later in the season.

2. Start-up of fisheries is expected to occur in a similar manner to recent past years, through an evaluation of relative stock proportions, as well as escapement past Mission and cumulative migration abundance in marine assessment areas of Early Summer and Summer-run stocks.

3. Canada has provided an escapement plan (a schedule of total mortality rates at various return abundances) for all stock groups including Late-run. Management adjustments based on river conditions for Early Stuart, Early Summer and Summer run stocks and based on river entry timing for Late-run stocks will be adopted by the Panel as necessary to increase the likelihood that target escapements reach the spawning grounds. The approach for Late-run sockeye varies from past years in which the Late-run exploitation rate was fixed based on pre-season assumptions.

4. Late-run sockeye are forecast to comprise more that half of the Fraser River sockeye return in 2006. The larger relative abundance combined with an anticipation of a longer fishing season associated with the higher exploitation rate target may provide the opportunity to update Late-run timing and abundance during the period of active in-season sockeye management. In addition, the PSC staff have developed models to predict the in-river migration timing and associated en route mortality of Late-run sockeye and will advise the Panel if changes to pre-season management adjustments are warranted. This will enable the Panel to assess the measured catch and escapement of Late-run stocks relative to expected levels based on the escapement plan and both pre-season and in-season assumptions of run timing and abundance.

5. However, staff will not be able to provide unique assessments for Cultus sockeye due to the low relative abundance of this stock and associated inability to estimate its stock proportions accurately in mixed stock samples. The exploitation rate (based on all catches downstream of the confluence of the Vedder and Fraser Rivers) of all Late-run stocks excluding Harrison will be used as a surrogate for Cultus exploitation rate. This method assumes that Cultus sockeye have similar timing as the other Late-run stocks and thus will have similar vulnerability to fisheries. Available data are insufficient to reject this assumption. Furthermore, this assumption is consistent with methods used to apportion catches in historical data that have been used to estimate past productivity and evaluate future Cultus sockeye recovery options.

6. The Panel has agreed to use a catch limit approach to evaluate Late-run impacts during the 2006 management season. For the Late-run aggregate, this catch limit will be interpreted as the available TAC, taking into account any in-season changes to abundance escapement targets, and/or management adjustments. For Cultus sockeye, the catch limit will be determined as a percentage of the total Late-run excluding Harrison. The catch limit will change in-season depending on the best estimates of Late-run abundance (excluding Harrison). It is important to note that the pre-season risk assessment was based on a fixed plan and thus did not quantify additional risk that may be associated with changing the plan in response to in-season assessments. Thus, the Panel may choose a cautious approach if additional harvest become available due to increases in Late-run abundance. The Panel has agreed to use DNA based stock identification techniques to estimate Late-run stock proportions and apply those estimates to catches to track Late-run impacts relative to the objectives.

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

APPENDIX F: 2006 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 22, 2006 (i.e., Regulatory Control letters).

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 2nd day of July, 2006, to the 9th day of September, 2006, 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 2nd day of July, 2006, to the 9th day of September, 2006, 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 2nd day of July, 2006, to the 30th day of September, 2006, 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 2nd day of July, 2006, to the 30th day of September, 2006, 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 2nd day of July, 2006, to the 14th day of October, 2006, both dates inclusive.

   b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 29 from the 2nd day of July, 2006, to the 14th day of October, 2006, 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 2006 season, the Fraser River Panel will adopt Orders establishing open fishing periods based on a 2006 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 2nd day of July, 2006 to the 9th day of September, 2006, 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 2nd day of July, 2006, to the 16th day of September, 2006, 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 17th day of September, 2006, to the 30th day of September, 2006, 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 2nd day of July, 2006, to the 9th day of September, 2006, 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 2nd day of July, 2006, to the 16th day of September, 2006, 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 17th day of September, 2006, to the 30th day of September, 2006, 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 2006 season, the Fraser River Panel will adopt Orders establishing open fishing periods based on a 2006 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: 2006 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 2006.

July 27, 2006
- United States
  - Treaty Indian Fishery
    - Areas 4B, 5 and 6C
      - Open to drift gillnets 12:00 p.m. (noon), Friday, July 28, 2006, to 12:00 p.m. (noon) Wednesday, August 2, 2006.

July 31, 2006
- United States
  - Treaty Indian Fishery
    - Areas 4B, 5 and 6C
      - Extended for drift gillnets from 12:00 p.m. (noon), Wednesday, August 2, 2006, to 12:00 p.m. (noon) Saturday, August 5, 2006.

August 2, 2006
- Canada
  - Areas 123, 124
    - Open to an Area G troll test fishery (likely 2 vessels) from 12:01 a.m., Thursday, August 3, 2006 for approximately 3 days (see DFO Fisheries Notice FN0608 for further information).
  - Area 29
    - Open to an Area E gillnet assessment fishery (2 vessels) starting Friday, August 4, 2006 (DFO will be announcing further details regarding this assessment fishery).

August 4, 2006
- Canada
  - Area 18-1, 18-4 and 18-1
    - Open to Area H troll 12:01 a.m., Tuesday, August 8, 2006, until further notice.
  - Area 124
    - Open to Area G troll 12:01 a.m., Monday, August 7, 2006, until further notice.
  - Area 123
    - Planned opening for Area G troll 12:01 a.m., Monday, August 7, 2006. To be confirmed by DFO on August 5.
- United States
  - Treaty Indian Fishery
    - Areas 4B, 5 and 6C
      - Extended for drift gillnets from 12:00 p.m. (noon), Saturday, August 5, 2006, to 12:00 p.m. (noon) Wednesday, August 9, 2006.
    - Areas 6, 7, and 7A
      - Open to net fishing from 4:00 a.m., Sunday, August 6, 2006 to 9:00 p.m. Sunday, August 6, 2006.
  - All Citizen Fishery
    - Areas 7 and 7A
      - Open to gillnets from 2:00 p.m. to 12:00 a.m. (midnight) Monday, August 7, 2006.
    - Areas 7 and 7A
      - Open to reefnets from 10:00 a.m. to 8:00 p.m., Monday, August 7, 2006.
    - Areas 7 and 7A
      - Open to purse seines from 8:00 a.m. to 6:00 p.m., Monday, August 7, 2006.

August 8, 2006

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon), Wednesday, August 9, 2006, to 12:00 p.m. (noon) Saturday, August 12, 2006.

Areas 6, 7, and 7A

Open to net fishing from 4:00 a.m., Thursday, August 10, 2006 to 10:00 p.m. Friday, August 11, 2006.

All Citizen Fishery

Areas 7 and 7A

Open to gillnets from 8:00 a.m. to 11:59 p.m. (midnight) Wednesday, August 9, 2006.

Areas 7 and 7A

Open to reefnets from 5:00 a.m. to 9:00 p.m., Wednesday, August 9, 2006.

Areas 7 and 7A

Open to purse seines from 5:00 a.m. to 9:00 p.m., Wednesday, August 9, 2006.

August 10, 2006

Canada

Area 29 – 1 to 6

Open to Area H troll from 12:00 p.m. (noon), Thursday, August 10, 2006 until further notice.

Area 20 – 1, 3, 4

Open to Area B purse seine in waters deeper than 55 meters or 30 fathoms from 6:00 a.m. to 7:00 p.m., Monday, August 14, 2006. Fishery may extend subject to by-catch concerns.

August 11, 2006

Canada

Area 29 – 1 to 7 and 29 – 9 to 17

Open to Area E gillnets from 9:00 a.m. to 7:00 p.m., Tuesday, August 15, 2006.

Areas 123, 124

Closes to Area G troll at 11:59 p.m., Friday, August 11, 2006.

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon), Saturday, August 12, 2006, to 12:00 p.m. (noon) Wednesday, August 16, 2006.

Areas 6, 7, and 7A

Extended for net fishing from 10:00 p.m., Friday, August 11, 2006 to 11:59 p.m. (midnight) Sunday, August 13, 2006.

All Citizen Fishery

Areas 7 and 7A

Open to gillnets from 8:00 a.m. to 11:59 p.m. (midnight) Monday, August 14 and from 8:00 a.m. to 11:59 p.m. (midnight) Tuesday, August 15, 2006.

Areas 7 and 7A

Open to reefnets from 5:00 a.m. to 9:00 p.m. Tuesday, August 15, 2006 and from 5:00 a.m. to 9:00 p.m. Wednesday, August 16, 2006.

Areas 7 and 7A

Open to purse seines from 5:00 a.m. to 9:00 p.m., Monday, August 14, 2006 and from 5:00 a.m. to 9:00 p.m., Tuesday, August 15, 2006.

August 14, 2006

Canada

Area 20 – 1, 3, 4

Open to Area B purse seine in waters deeper than 55 meters or 30 fathoms from 6:00 a.m. to 7:00 p.m., Tuesday, August 15, 2006. Fishery may extend subject to by-catch concerns.

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

Closes to Area H troll: Traditional Fishery 11:59 p.m. Monday, August 14, 2006. The Area H troll: ITQ Demonstration Fishery remains open until further notice in these areas (see DFO Fishery Notice FN0693 for further details).

August 15, 2006

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon), Wednesday, August 16, 2006, to 12:00 p.m. (noon) Saturday, August 19, 2006.

Areas 6, 7, and 7A

Open for net fishing from 4:00 a.m., Wednesday, August 16, 2006 to 10:00 p.m. Thursday, August 17, 2006.

August 17, 2006

United States

All Citizen Fishery

Areas 7 and 7A

Open to gillnets from 8:00 a.m. to 11:59 p.m. (midnight) Friday, August 18, 2006.

Areas 7 and 7A

Open to reefnets from 5:00 a.m. to 9:00 p.m. Saturday, August 19, 2006.

Areas 7 and 7A

Open to purse seines from 5:00 a.m. to 9:00 p.m., Friday, August 18, 2006.

August 18, 2006

Canada

Area 20 – 1, 3, 4

Open to Area B purse seine in waters deeper than 55 meters or 30 fathoms from 6:00 a.m. to 7:00 p.m., Monday, August 21, 2006. Fishery may extend subject to by-catch concerns (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 7 a.m. to 9:00 p.m., Tuesday, August 22, 2006. There will be a possible re-opening of this fishery on Wednesday. (Please refer to the DFO Fishery Notices for further updates that will be available Tuesday evening).

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon), Saturday, August 19, 2006, to 12:00 p.m. (noon) Wednesday, August 23, 2006.

Areas 6, 7, and 7A

Open to net fishing from 4:00 a.m., Monday, August 21, 2006 to 10:00 p.m. Tuesday, August 22, 2006.

All Citizen Fishery

Areas 7 and 7A

Open to gillnets from 8:00 a.m. to 11:59 p.m. (midnight) Wednesday, August 23, 2006.

Areas 7 and 7A

Open to reefnets from 5:00 a.m. to 9:00 p.m. Sunday, August 20, 2006.

Areas 7 and 7A

Open to purse seines from 5:00 a.m. to 9:00 p.m., Wednesday, August 23, 2006.

August 21, 2006

Canada

Area 20 – 1, 3, 4

Open to Area B purse seine in waters deeper than 55 meters or 30 fathoms from 6:00 a.m. to 7:00 p.m., Tuesday, August 22, 2006. Fishery may extend subject to by-catch concerns (Please refer to DFO Fishery Notices for further details).

August 22, 2006

Canada

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

Closes to Area H troll: ITQ Demonstration Fishery 11:59 p.m., Tuesday, August 22, 2006.

Area 20 – 1, 3, 4

Closes to Area B purse seine at 7:00 p.m., Tuesday, August 22, 2006. There will not be a fishery in this area on Wednesday, August 23, 2006; please refer to the DFO Fishery Notices for further details.

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

Closes to Area E gillnets at 9:00 p.m., Tuesday, August 22, 2006. There will not be a fishery in this area on Wednesday, August 23, 2006 ; please refer to the DFO Fishery Notices for further details.

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Closes to drift gillnets at 12:00 p.m. (noon) Wednesday, August 23, 2006.

Areas 6, 7, and 7A

Closes to net fishing at 10:00 p.m. Tuesday, August 22, 2006.

All Citizen Fishery

Areas 7 and 7A

The previously announced gillnet fishery that was to occur on Wednesday, August 23, 2006, has been cancelled.

Areas 7 and 7A

The previously announced purse seine fishery that was to occur on Wednesday, August 23, 2006, has been cancelled.

August 25, 2006

Canada

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

Open to Area E gillnets from 7 a.m. to 7:00 p.m., Tuesday, August 29, 2006. There will be a possible re-opening of this fishery on Wednesday. (Please refer to DFO Fishery Notices for further updates).

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Open to drift gillnets from 5:00 p.m. Friday, August 25, 2006, to 12:00 p.m. (noon) Wednesday, August 30, 2006.

Areas 6, 7, and 7A

Open to net fishing from 4:00 a.m., Monday, August 28, 2006 to 10:00 p.m. Tuesday, August 29, 2006.

All Citizen Fishery

Areas 7 and 7A

Open to gillnets from 9:00 a.m. Wednesday, August 30, 2006 to 1:00 a.m. Thursday, August 31, 2006.

Areas 7 and 7A

Open to reefnets from 5:00 a.m. to 9:00 p.m. Wednesday, August 30, 2006.

Areas 7 and 7A

Open to purse seines from 6:00 a.m. to 9:00 a.m., Wednesday, August 30, 2006.

August 29, 2006

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Wednesday, August 30, 2006, to 12:00 p.m. (noon) Saturday, September 2, 2006.

September 1, 2006

Canada

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

Open to Area E gillnets from 8 a.m. to 8:00 p.m., Tuesday, September 5, 2006. (Please refer to DFO Fishery Notices for further details).

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon) Saturday, September 2, 2006, to 12:00 p.m. (noon) Saturday, September 9, 2006.

Areas 6, 7, and 7A

Open to net fishing from 4:00 a.m., Tuesday, September 5, 2006 to 8:00 a.m. Wednesday, September 6, 2006.

All Citizen Fishery

Areas 7 and 7A

Open to gillnets from 3 p.m. to 11:00 p.m. Wednesday, September 6, 2006.

Areas 7 and 7A

Open to reefnets from 5:00 a.m. to 9:00 p.m. Wednesday, September 6, 2006.

Area 7A

Open to purse seines from 8:00 a.m. to 11:00 a.m., Wednesday, September 6, 2006.

Fraser River Panel control of Panel Areas was relinquished in accordance with the pre-season regulations (Appendix F): (1) Canada: Area 20 on September 9; Areas 17 and 18 on September 30; and Area 29 on October 14; (2) United States: Areas 4B, 5 and 6C on September 9; Areas 6, 7 and 7A on September 16; and the remaining portions of Area 7A (Near Point Roberts) on September 30.

APPENDIX H: PSC STOCK MONITORING AND IDENTIFICATION PROGRAMS

Stock Monitoring

The goal of the stock monitoring program is to assess total abundance, daily abundance and migration timing of Fraser River sockeye and pink salmon at different points along their migration route. This information is required for the development of fishing plans that aid in meeting escapement and catch allocation objectives. Commercial catches have historically provided much of the data used in the analyses, however, limited commercial fishing in recent years has reduced the availability of this information. Test fisheries conducted by the Commission or by DFO (at the Commission's request) provide important data before and after the commercial fishing season and between fishing periods. Information about upstream migration in the Fraser River is primarily obtained by the hydroacoustic program at Mission, B.C., visual observations at Hells Gate and analysis of catches in Fraser River First Nations fisheries. Furthermore, diversion rate via Johnstone Strait is assessed weekly during the in-season period.

Between June 25 and September 24, estimates of Mission sockeye escapements by stock group were derived by applying species composition data to the hydroacoustic estimates. Prior to June 25 and after September 24, upstream passage was monitored solely using Whonnock (Area 29-16) test fishing data. Daily observations at Hells Gate between July 6 and September 30 provided qualitative information on the success of upstream fish passage and abundance.

A. Sockeye Salmon

Estimation of total Fraser River sockeye abundance by stock group is primarily based on catch, effort, escapement, stock composition and diversion rate data. These data are analysed using cumulative-normal, cumulative-passage-to-date and Bayesian models, which are described in the Pacific Salmon Commission's Technical Report No. 61 and the Fraser River Panel's 1995 Annual Report2. Commercial fishing was very restricted in 2006, so test fishing catch and CPUE data were used extensively for assessing abundance by stock group.

B. Split-Beam Hydroacoustic Study at Mission

PSC Staff have operated a hydroacoustic facility on the Fraser River near the Mission Bridge since 1977, for the purpose of providing timely in-season estimates of sockeye escapement through marine and lower river fisheries. This program has benefited from improved technologies and research in recent years (Xie et al. 20053, 20074, 20085).

This year marked the third season of official estimates produced by a split-beam hydroacoustic system on the south shore (i.e., "left bank") of the Fraser River, with the primary effort directed at producing timely, accurate and robust estimates of daily abundance. Additional work was focused on gathering independent diagnostic information (e.g., using a DIDSON hydroacoustic system) to verify assumptions used in the estimation procedure. Using software specifically designed for the PSC's Mission hydroacoustic program, analytical algorithms were implemented that streamlined data processing and facilitated timely estimates of daily fish passage. Estimates from the split-beam system rely on multiple data streams that provide information about target density, fish behaviour, vessel speed and transducer placement. The

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[1] 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.

[2] 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.

[3] Xie, Y, A.P. Gray, F.J. Martens, J. L. Boffey, and J.D. Cave. 2005. Use of Dual-Frequency Identification Sonar to Verify Split-Beam Estimates of Salmon Flux and to Examine Fish Behaviour in the Fraser River. Pacific Salmon Commission technical Report. No. 16; 58 p.

[4] 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.

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

updated software contained built-in data checking and verification procedures that alert users to data problems and allow them to initiate correction protocols.

This was also the first year that an independent side-scan split-beam system was fully operational on the north shore (i.e., "right bank") for the entire sockeye escapement period. The data were processed and cleaned with a 24-hour turn-around time. Information from the right-bank system was not used to produce official in-season estimates in 2006, but was used in post-season analyses to verify that there were no significant discrepancies between cross-river abundance estimates from the current method versus a method that encompassed right-bank information.

Data were also collected using the traditional single-beam hydroacoustic system. Estimates using various combinations of single and split-beam data were compared during post-season investigations. None of these comparisons provided evidence for a low bias of sufficient magnitude to explain the deviations observed between Mission and upstream estimates (see Appendix I for details).

Stock Identification

PSC staff conduct programs designed to estimate stock proportions of Fraser River sockeye salmon along their migration route. These estimates are used to partition catches into stocks or stock groups in commercial, test and First Nations fisheries. Stock identification data are also used to apportion the daily estimates of sockeye escapement past Mission into discrete stock groups. The combined catch and escapement by stock information is used to generate the abundance and timing estimates for the sockeye management groups required for management decisions. Stock identification methods for sockeye salmon in 2006 used DNA[1] and scale pattern analyses[2] from fish caught in marine and in-river fisheries.

Analyses of samples from catches in commercial and test fisheries were conducted daily, beginning in late June and continuing through late September. Staff sampled test fishing catches and commercial sockeye landings at several sites in British Columbia (Greater Vancouver, Port Renfrew, Nanaimo, Port Hardy, Quadra Island and Campbell River) and Washington (Bellingham and Neah Bay). The Alaska Department of Fish and Game (ADF&G) collected samples for the PSC from the District 104 purse seine fishery, while DFO provided samples from test fisheries in Johnstone Strait and the west coast of Vancouver Island. In addition, at the PSC's request, DFO and First Nations personnel coordinated weekly scale sampling of Fraser River First Nations fisheries.

The per-sample cost of DNA analysis dropped in 2006 and the number of samples analysed increased. This increased data collection facilitated investigations into sources of variance in estimated stock proportions among adjacent samples and gear types. These investigations suggested that some inter-sample variance is contributed by patchy distributions of sockeye stocks on local scales. Further work will be performed in subsequent years with the goals of understanding and quantifying additional sources of variation and determining whether variation can be reduced by changing sampling procedures. Other biological data such as scale patterns, age and size will be used to augment these analyses.

Stock identification data are also used to account for Fraser River sockeye wherever they may be caught. In 2006, discriminant function analysis of scale variables for age 4_2 sockeye remained the main technique to estimate proportions of Fraser River sockeye in District 104 fisheries. On the basis of estimated age compositions of Fraser sockeye in Area 12 and 20 test fisheries, these estimated proportions were then expanded to account for other ages. District 104 purse seine catches in 2006 included 242,000 sockeye, of which approximately 67% were age 4_2. Nearly 11% of these fish were estimated to be Fraser River age 4_2 sockeye, and Fraser sockeye contributed less to catches of other age groups. Approximately 20,000 sockeye caught in District 104 were estimated to be of Fraser River origin.

[1] 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.

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

APPENDIX I: POST-SEASON ESTIMATES OF THE TOTAL NUMBER OF RETURNING SALMON

In the past, the sum of spawning escapements and total catches in all fisheries has been used to obtain post-season estimates of the total number of returning salmon. There has been evidence that these estimates may be biased low, however, especially during years of large en route losses and incomplete escapement estimates such as observed in several recent years. To minimize biases in total abundance estimates, alternative estimation methods have been used, such as the sum of Mission escapements and total catches in all fisheries downstream of Mission.

In 2006, however, post-season spawning escapement estimates from DFO were substantially larger than expected by subtracting in-river catches upstream of Mission from in-season estimates of escapement past Mission. Furthermore, based on a large-scale radio telemetry program, there was evidence of in-river mortality. This information led the PSC, DFO and LGL (consultancy responsible for radio tagging program) to investigate alternate methods of estimating the total number of returning salmon. Because the alternative methods varied in the components used, PSC staff investigated the various sources of bias in the components to determine which method would generate the most accurate estimates. The alternative total abundance and bias estimates were vetted through and approved by the Fraser River Panel Technical Committee. With the exception of Early Stuart and Pitt sockeye, the method selected to generate post-season estimates of total return resulted in increased abundances relative to in-season estimates.

Alternative post-season abundance estimates

Staff generated estimates of total return based on the following methods:

1. In-season Mission escapement estimates plus all marine catches and in-river catches downstream of Mission.
2. Spawning ground estimates plus catches downstream of spawning areas.
3. Spawning escapements plus catches downstream of spawning areas and predicted DBEs from the management adjustment models.
4. Projected total abundance from marine test fishery Catch Per Unit of Effort (CPUE) and historical expansion lines.
5. Spawning escapement estimates divided by the annual estimates of radio tag survival plus catches downstream.
6. Adjusted Mission escapements based on weekly radio tag estimates of survival plus catches downstream.

Most of these methods do not require further explanation, except for method 6 which used the following procedure:

a. Spawning ground estimates were summed for each of the four main stock aggregates (Early Stuart, Early Shuswap, Summer-run and Late Shuswap) for which radio tag estimates of survival were available.

b. The aggregated totals were divided by radio-tag derived total survival rates between Mission and the spawning grounds to generate revised Mission escapement estimates. The total survival rates used in this calculation were estimated from the ratio of tags arriving at the spawning areas to tags detected passing Mission, and thus reflected total survival from fishery-related and natural mortality. Total survival rates for each of the four aggregates were calculated as the average of weekly survivals weighted by in-season Mission estimates for each aggregate.

c. The revised Mission totals for each aggregate were then apportioned to days based on in-season Mission profiles. This initial calculation assumes equal bias for each day's estimate of a stock aggregate but not for the daily Mission totals, since different stock aggregates will have different biases and the bias in total sockeye estimates will be the sum of biases for all stocks that passed Mission on a given day.

d. Stock proportion estimates from DNA analyses were then applied to the revised Mission totals to obtain revised daily profiles for each aggregate.

e. Due to feedback between the weighted annual survival estimates and the Mission profile, this analysis involved an iterative process with the tag survival calculations. Thus, total

survival rates were recalculated based in the revised profiles from step ‘d’ and then applied to the spawning escapements in step ‘b’. The steps were then repeated until the total survival estimates from successive steps converged.

The potential sources of bias in the various components of these six alternate methods are explored below.

Sources of bias

The following components used to estimate total escapement were investigated as potential sources of bias: (a) Mission escapement estimates (methods 1 and 6) ; (b) stock proportions applied to Mission estimates (methods 1and 6); (c) spawning escapement estimates (methods 2, 3, 5 and 6); (d) estimates of in-river survival from radio tagging (methods 5 and 6); (e) in-river catch estimates (methods 1, 2 and 3) ; and (f) expansion lines used to predict Mission escapements from marine purse seine test fishery catches (method 4).

(a) Mission escapement estimates

An extensive analysis was conducted to identify potential sources of bias in the Mission escapement estimates. Conclusions were as follows:

1. Raw data collected at Mission in 2006 are consistent with past years.
2. The estimation algorithms used in 2006 are the same as in past years, and generated comparable daily estimates given similar data inputs.
3. Estimates from single and split-beam systems were similar, which indicated there were no problems with the equipment. Neither of the two systems generated estimates during late August and September that were near the levels implied by upstream estimates.
4. Single-beam estimates were larger than split-beam estimates because they included downstream migrating targets. Although deviations between the estimates increased in August and September, the temporal pattern of the deviations is consistent with increased abundances of Late-run sockeye and with milling behaviour.
5. The relationship between targets per transect and total daily salmon abundance from the single-beam system was similar to the observations for 1998, 2002 and 2006 cycle years, which indicates there are no systematic problems with the single-beam abundance estimates.
6. Through much of the summer of 2006, Fraser River flows were the lowest in nearly 60 years of records. The low flows resulted in much less glacial siltation and increased water clarity. River test fishermen reported they could see their gillnets down to depths of 2 m. These low flows likely caused aspects of fish behaviour to differ from past years, including: (a) fewer fish detected near the water surface by the mobile system; (b) a more even cross river distribution of fish; (c) a higher fraction of downstream migrating fish swimming offshore from the left bank (i.e., south shore); and (d) a decreased swimming speed of upstream migrating fish through the season. Of these fish behaviour issues, item (a) is consistent with fish dispersing in response to the approach of the transecting vessel (i.e., boat avoidance), which causes negative biases in Mission estimates. The magnitude of this potential negative bias would increase due to item ‘b’, because a larger fraction of the total estimate would come from the vessel rather than the shore based systems. Negative bias may also have been caused by salmon migrating near the river bottom, where fish are difficult to detect using hydroacoustic methods.

More detailed investigations therefore focused on the effects of boat avoidance and migration near the riverbed on abundance estimates from the acoustic survey systems, from mid-August to September.

The conclusions of these more detailed analyses were as follows. First, the blind zone near the riverbed represents about 13% of the sampled area and by itself could have resulted in underestimates of 2-18% by the mobile system. Second, comparisons between abundance estimates in areas sampled by both the left bank acoustic system and the mobile vessel showed possible effects of boat avoidance on depth distribution and upstream speed, but not on downstream ratio or the abundance estimate. However, interpretations are confounded because the mobile vessel sampled 50-100 m downstream of the area surveyed by the left bank acoustic system. A comparison of day versus night target distributions found a similar diurnal pattern,

which does not support a severe boat avoidance effect. Counteracting these sources of negative bias, a positive bias was generated by the application of left bank statistics (downstream ratio and fish speed) to the mobile targets. When the compensating biases identified above are quantified, an overall positive bias is obtained, which is opposite of what was expected from the upstream estimates.

In 2006, an experimental program was conducted on the right bank (i.e., north shore). The successful implementation of this program allowed hydroacoustic staff to generate estimates for the July 22-Sept. 18 period based on left bank, mobile and right bank sampling. Total salmon abundance estimates from this sampling scheme totalled approximately 340,000 fish more than estimated by the left bank and mobile sampling program. However, most of the cumulative deviation between the two estimates was due to differences during a few days only, and the cumulative difference of 340,000 salmon still does not account for the large discrepancies between Mission and upstream estimates. Thus, it appears unlikely that full implementation of a right bank program would resolve the issues that were responsible for biases at Mission in 2006.

Quantification of the magnitude of bias due to boat avoidance is not possible with the available data. However, boat avoidance remains the most likely source of negative bias in Mission estimates given the extremely low river flows in 2006.

(b) Stock proportions applied to Mission estimates

Errors in stock proportion estimates have no effect on estimates of total sockeye abundance, and thus cannot be used to explain the overall discrepancies between Mission and upstream estimates. However, biases in stock proportions do effect estimates for individual stock aggregates. Therefore, we assessed the potential contribution of stock identification bias to the discrepancy between Mission and spawning ground abundance estimates. DNA-based estimates of stock proportions vary only slightly between in-season and post-season periods, which eliminates significant bias due to changes in stock proportion estimates. We also looked for evidence of sampling bias by comparing stock proportions from river gillnet test fisheries with those from marine purse seine test fisheries (lagged for travel time). The temporal pattern of stock proportions was very similar for the two gear types, which indicates that sampling bias in river gillnet test fisheries was not a major problem.

(c) Spawning escapement estimates

Approximately 74% of the total spawning escapement came from rivers where mark-recapture (M-R) methods were used, 15% came from census methods (either spawning channel or fence counts) and the remaining 11% came from visual surveys. The process to generate spawning ground estimates includes routine bias checks for M-R estimates. Violations of M-R assumptions were found in 2 of the 7 programs (Seymour River in the Early Summer management group and Lower Adams in the Late-run group). However, in both cases the violations (i.e., non-proportional application and recovery) would be expected to result in negative biases. Negative biases were also attributed to some Early Summer populations as a result of the visual survey methods, and to Quesnel sockeye in the Summer-run group due to a very small lake spawning component that was not assessed in 2006. A further negative bias in Late-run estimates due to a large pre-spawn mortality in Shuswap lake is not a bias in spawning escapement estimates per se, since this mortality did not occur in traditionally surveyed areas (i.e., the mortality occurred outside of normal spawning ground areas). However, this mortality was an important component in assessments of radio tagging estimates of survival (see below). The conclusion of these analyses was that the spawning escapement estimates were biased low, which is in the opposite direction needed to explain the observed discrepancies between Mission and upstream estimates.

(d) Estimates of in-river survival from radio tagging

Estimates of in-river survival obtained from the radio tagging program were also scrutinized. Two issues were identified with the estimates in 2006. First, the radio receiver at the mouth of the Lower Adams River did not function properly because of a faulty wire and the antenna was not optimally located to detect migrating fish. As a consequence, survival could only be estimated reliably to the Little River receiver, and not to individual spawning grounds. Survival to the Shuswap River could in theory have been estimated, but DNA-based discrimination of Late-run stocks in Shuswap Lake is not accurate enough to distinguish Lower Shuswap from Lower Adams, and only a small number of radio-tagged fish were detected at the Lower Shuswap

receiver (n=22). Because the receiver malfunctioned at Lower Adams River, an estimate of the total run to Shuswap Lake and separate estimates for both traditional and non traditional spawning areas were required to estimate survival rates for stocks that migrated past the Little River receiver.

DFO and LGL staff worked together to assign fates to all radio-tagged fish that passed the Little River receiver. Radio-tagged fish that were assigned to traditional spawning areas would be accounted for in the spawning ground estimates, while the remaining radio-tagged fish would be assigned to non-traditional spawning areas. Two alternate methods were used to estimate the number of fish in non-traditional and therefore non-enumerated spawning areas. The two methods differed in the technique used to estimate the number of radio tags that entered the Adams River and they assumed different ratios of tagged versus un-tagged fish. The resulting estimates of fish that were not accounted for in traditional spawning areas were 284,000 and 584,000 fish, respectively. Because these estimates likely bounded the true value, the Technical Committee agreed to use the average of these two estimates (434,000 fish) when calculating the total run to Shuswap Lake. In any case, the range of these estimates was small relative to the total of 2,896,000 fish accounted for in traditional spawning sites in the Shuswap Lake area (including Little River).

The second issue with estimates obtained from the radio tagging program in 2006 revolved around whether survival of radio-tagged fish could be considered representative of the survival of untagged fish. There were two main components to this discussion. First, all radio-tagged fish were physio-sampled in 2006, and a study conducted in 2005 showed that physio-sampled and radio-tagged fish had a 7% lower survival rate than fish that were only radio tagged. Although the survival difference in the 2005 study was not statistically significant and it was not possible to quantify this effect in 2006 (since all tagged fish were also physio-sampled), the 2005 results suggest that survival estimates for radio-tagged fish were likely biased low when applied to untagged fish in 2006. The second component revolved around observations in 2006 and other years of higher fractions of radio-tagged fish observed in areas where pre-spawn and en route mortality occurred, compared to fractions on spawning grounds. These areas where mortality occurred include the Shuswap Lake shoreline in 2006 and areas like Bridge River and Williams Lake Creek (Summer-run fish) in 2005. It is important to note that the small numbers of tags involved in assessments of these areas resulted in low precision estimates. Also, since in most cases observations were associated with non-traditional areas, rigorous programs were not in place to estimate the untagged components (i.e., the denominator of the tag ratio).

Nonetheless, these observations suggest a chronic tagging effect on the survival of radio-tagged fish that may extend upriver to near the spawning grounds. Survival estimates were adjusted for acute tagging effects by removal of tag-induced losses below Sawmill Creek. With respect to 2006, a comparison was made of travel times for fish tagged in marine versus in-river areas. Median travel times were identical for tagged Late-run sockeye from marine versus in-river release sites. However, for Early Summer and Summer-run sockeye, fish tagged in the river moved slower in some reaches of the Fraser than comparable marine-tagged sockeye, but statistically significant effects were only detected in two reaches for Summer-run sockeye. The effect of this second component, “chronic tag effects”, is that radio-tagged estimates of survival are biased low. While the Technical Committee agreed that some of the losses above Sawmill could have been due to tagging related effects, the bias introduced by using the radio tagging estimates of survival was thought to be small relative to the discrepancies between Mission and upstream estimates. The Technical Committee therefore agreed to use the tagging data as “the best data available”.

(e) In-river catch estimates

Unlike in some past years when there were allegations of “missing fish”, the direction of discrepancies in 2006 focused the analysis on potential sources of catch overestimates rather than underestimates. A review of potential sources of bias for in-river catch estimates was provided by DFO. For the mid and upper Fraser areas, estimates may be biased low (by a relatively small amount) due to a combination of monitoring gaps and data pooling issues associated with survey methods. No source of positive bias was identified for these areas. For the Lower Fraser Area, a number of potential sources of positive bias were investigated. These included the possibility of double-counting Economic Opportunity fishery catches in census programs at two locations (e.g., at catch locations and mandatory landing sites), though it was thought to occur infrequently and

not introduce a significant overall bias. For FSC fisheries, there was the potential for double-counting if catches were included in FSC catch estimates and subsequently sold to Economic Opportunity fishers and counted at a mandatory landing site. While there is an economic incentive for this activity, there was little overlap between FSC and Economic Opportunity fisheries to make this a frequent occurrence or a source of large positive bias. A third source of positive bias in FSC catches could occur if the surveyed CPUE used to estimate catches was biased high (e.g., by surveying only better than average fishermen). A fourth source of positive bias could occur if fish from FSC fisheries in upstream areas were landed at mandatory landing sites in the lower river. While it was not possible to quantify the exact magnitude of these biases, the overall bias was thought to be small relative to the magnitude of the catch estimates.

(f) Expanded abundances from marine purse seine test fishery catches

Projections from marine purse seine test fishery CPUEs also suggested that more fish should have arrived at Mission than were estimated by the Mission hydroacoustics program. Thus, we generated estimates of total return based on these programs for comparison with other estimates. Expanded estimates of abundance from test fisheries are subject to two main sources of bias: (1) catch estimation bias associated with catch hails and (2) bias in estimates of test fishery expansion factors. In the case of catch estimation bias, significant fractions of the projected total Summer and Late-run abundances were associated with two very large CPUE days that occurred in Johnstone Strait during the third week of August. Discussion with DFO staff suggested that while there were likely errors associated with the CPUE estimates on these days, there was no indication they were biased high and they could equally likely be biased low. The expansion lines applied in 2006 were based on past years' averages. Given that expansion lines vary considerably among years, the 2006 lines may have been lower than average. However, significantly lower expansion lines would generate abundance estimates that are inconsistent with upstream estimates.

Discussion and Conclusion

Alternative estimates of the total numbers of returning salmon by stock aggregate are shown in Table 1. Estimates of total sockeye return range from 8.5 million to 14.5 million. A detailed examination of the Mission estimation method could not quantify a bias large enough to account for the discrepancies between Mission and upstream data. Nonetheless, sources of negative bias related to boat avoidance were more prevalent in 2006 than in past years. Furthermore, alternative estimates of both upstream (spawning escapements) and downstream (expanded purse seine catches) abundances suggest that Mission estimates may have been subject to substantial negative bias in 2006. Thus method 1 was rejected as it was likely biased low. No significant biases were detected in spawning escapement estimates, but there was strong evidence from the radio telemetry program of en route losses in all stock aggregates. Method 2 was therefore also rejected as it does not account for en route losses and would also be biased low. Method 4 was rejected because of the large inter-annual variation in the expansion lines that are applied to marine test fishery CPUEs. The 2006 expansion line may have differed from the historical average used in the calculations, but this could not be determined without an independent abundance estimate. The remaining three methods (3, 5 and 6) all use spawning ground estimates, but vary in the factors used to account for potential in-river losses. Method 3 added the DBEs projected from management adjustment models to account for en route losses. This method was rejected because the radio telemetry program provided a more direct estimate of survival. Furthermore, if method 3 was used it would create circularity in the use of the DBEs from 2006 in future years' MA models. Method 5 applied the annual ratios of tags reaching the spawning grounds to tags detected passed Mission. However, the radio tagging data could also be used to generate weekly estimates of survival. Both the weekly estimates of survival and the abundance associated with each weekly tag group tended to increase over time. Method 5 was therefore rejected since it did not account for this temporal variation.

Thus, the investigation of biases in the components led PSC staff and the Technical Committee to recommend that method 6 (adjusted Mission escapements plus catches downstream) be used to calculate the best post-season estimate of total abundance for each stock group (Table 1). Caveats that accompany this recommendation are that survival rates from radio-tagged fish likely underestimate the survival of un-tagged fish, due to the effects of tagging and physiological sampling, and thus estimates of total return should be viewed as overestimates. It is not possible to quantify the exact magnitude of this potential bias, but if the estimates in Table 1 bracket the true

range of potential estimates, we suspect the magnitude of remaining bias is low relative to the total estimates. The final post-season estimates of total return are 56,000 Early Stuart, 1.8 million Early Summer, 2.5 million Summer, 635,000 Birkenhead and 8.0 million Late-run sockeye, for a total Fraser sockeye return of 13.0 million.

Table 1. Alternative estimates of total run by management group.

	"Traditional methods"				Radio tagging methods	
	1	2	3	4	5	**6**
Management or Stock Group	In-season Mission plus catch downstream	Spawning escape. plus catches downstream	Spawning Escapements plus DBE plus catches downstream	Projected Total abundance from Marine test fisheries	Spawning escapement annual surv. plus catches downstream	**Adjusted Mission plus catches downstream**
Early Stuart	**67,000**	**45,000**	**134,000**	**59,000**	**56,000**	**56,000**
Early Summer	**1,424,000**	**1,202,000**	**1,400,000**	**1,994,000**	**1,630,000**	**1,818,000**
Scotch-Seymour	1,064,000			1,610,000	1,322,000	1,374,000
Early Misc	262,000			384,000	236,000	375,000
Pitt	98,000				72,000	69,000
Summer	**1,925,000**	**2,175,000**	**2,191,000**	**2,629,000**	**2,562,000**	**2,512,000**
Chilko/Quesnel	1,509,000			2,053,000	1,980,000	1,994,000
L.Stuart Stellako	416,000			576,000	582,000	518,000
Birkenhead	**353,000**	**478,000**	**478,000**	**750,000**	**633,000**	**635,000**
"True" Late	**4,804,000**	**6,210,000**	**8,278,000**	**9,118,000**	**7,913,000**	**7,958,000**
Late Shuswap	4,507,000			8,926,000	7,522,000	7,464,000
Weaver	150,000				225,000	286,000
Harrison	147,000			192,000	166,000	208,000
Total	**8,573,000**	**10,110,000**	**12,481,000**	**14,550,000**	**12,794,000**	**12,979,000**

Recommendations

Staff and the Technical Committee made the following recommendations as a consequence of this work:

1. Continue to explore sampling schemes at Mission that minimize the impacts of boat avoidance. The right bank program will be continued in 2007, with full implementation expected in 2008. Experiments will be conducted in 2007 using a stationary vessel with a sideward-looking acoustic survey system, similar to that used on the left and right banks.
2. Future radio tagging and physiological sampling programs should always include controls, so the incremental effects of sampling on survival can be quantified. If possible, comparisons of survival rates of radio-tagged and disk-tagged fish could be used to partially quantify the effects of radio tagging on survival. This type of comparison might be possible in the future if a lower Fraser River tagging platform is implemented.
3. In cases where radio tags are observed in non-traditional areas, contingency plans should be in place to improve assessments of total populations in those locations so that tagged versus untagged fish ratios can be accurately quantified.
4. Summaries of analyses conducted should be documented in the Fraser River Panel annual report and in notes associated with pertinent databases so that future researchers will be able to understand assumptions made in generating post-season estimates of the 2006 Fraser River sockeye return.

APPENDIX J: HISTORICAL CATCH, ESCAPEMENT AND PRODUCTION DATA, AND DETAILED 2006 TAC CALCULATION

Table 1. Catch by user group, spawning escapement, DBE and abundance of Fraser River sockeye salmon for cycle years 1994-2006.

	Fraser Sockeye			
	1994	**1998**	**2002**	**2006**
CANADIAN CATCH				
Panel Area	2,729,000	283,000	1,352,100	921,000
Non-Panel Areas	7,306,000	995,000	866,200	2,326,000
Commercial Catch	**10,035,000**	**1,278,000**	**2,218,300**	**3,247,000**
Marine FSC	183,000	200,000	265,000	298,000
Fraser River FSC	928,000	644,000	770,000	393,000
Economic Opportunity	0	0	120,000	455,000
First Nations Catch	**1,111,000**	**844,000**	**1,155,000**	**1,146,000**
Marine Recreational	14,000	0	5,000	37,000
Fraser Recreational	0	18,000	123,000	134,000
Charter	24,000	0	7,000	600
ESSR	0	99,000	109,000	6,900
Non-commercial Catch	**38,000**	**117,000**	**244,000**	**179,000**
Canadian Total	**11,184,000**	**2,239,000**	**3,617,300**	**4,572,000**
UNITED STATES CATCH				
Treaty Indian	951,000	293,000	298,000	487,000
Non-Indian	877,000	229,000	136,000	216,000
Commercial catch	**1,828,000**	**522,000**	**434,000**	**703,000**
Ceremonial	0	0	15,000	4,500
Recreational	0	0	0	0
Non-commercial Catch	**0**	**0**	**15,000**	**4,500**
Washington Total	1,828,000	522,000	449,000	708,000
Alaska	256,000	186,000	1,000	20,000
United States Total	**2,084,000**	**708,000**	**450,000**	**727,000**
TEST FISHING CATCH				
Canada	38,000	74,000	141,000	63,000
United States	2,000	0	0	9,400
Commission (Panel Areas)	40,000	74,000	141,000	72,000
Canada (non-Panel Areas))	14,000	33,000	15,000	68,000
Test Fishing Total	**54,000**	**107,000**	**156,000**	**140,000**
TOTAL CATCH				
Total Catch in All Fisheries	13,322,000	3,054,000	4,223,300	5,439,000
Adult Spawning Escapement	3,133,000	4,425,000	10,200,600	4,661,000
Jack Spawning Escapement	0	0	5,400	1,700
Differences between Estimates	786,000	3,394,000	708,000	2,879,000
Total Abundance	**17,241,000**	**10,873,000**	**15,137,300**	**12,981,000**

Table 2. Catches of Fraser River sockeye salmon in Canadian First Nations fisheries by area for cycle years 1994-2006.*

Fishing Area		1994 **	1998	2002	2006
Fraser River Mainstem					
Below Port Mann	*1*	147,600	101,300	129,600	158,300
Port Mann to Mission	*1*	103,300	77,300	118,500	120,400
Mission to Hope		194,900	88,100	147,100	169,400
Hope to Saw mill Cr.		201,800	187,900	261,200	183,600
Saw mill Cr. to Kelly Cr.		232,200	126,700	164,200	129,200
Kelly Creek to Naver Cr.		10,600	8,100	11,700	4,700
Above Naver Cr.		1,500	5,400	9,300	5,100
Total		891,900	594,800	841,600	770,700
Tributaries					
Harrison/Lillooet System		n/a	n/a	n/a	n/a
Thompson System		3,400	4,400	9,400	56,500
Chilcotin System		27,200	36,300	13,200	13,700
Nechako System		3,700	3,400	100	5,300
Stuart System		1,600	4,700	6,400	1,600
Total		35,900	48,800	29,100	77,100
Total Fraser Catch		927,800	643,600	870,700	847,800
Marine Areas		170,800	200,000	264,700	297,700

* Data supplied by DFO.

** Catch estimates from the report of the In-river Catch Estimation Work Group to the Fraser River Sockeye Public Review Board, 1994.

1 Prior to 1995, the divisions were Steveston, and Deas to Mission.

Table 3. Escapements of sockeye salmon to Fraser River spawning areas for cycle years 1994-2006.

DISTRICT Run-timing Group Stream/Lake	Estimated Number of Adult Sockeye * 1994	1998	2002	2006
NORTHEAST				
Upper Bowron R.	4,380	4,751	8,770	1,501
STUART				
Early Stuart				
Takla L. Streams	10,512	23,801	15,462	17,569
Middle R. Streams	13,021	5,822	5,683	11,569
Trembleur L. Streams	5,592	2,947	3,492	6,671
Early Stuart Total	29,125	32,570	24,637	35,809
Late Stuart				
Middle R.	29,573	38,906	7,452	7,513
Tachie R.	42,571	92,963	19,608	14,178
Miscellaneous	4,318	6,528	7,438	5,813
Late Stuart Total	76,462	138,397	34,498	27,504
NECHAKO				
Nadina R. (Late)	86	756	421	4,144
Nadina Channel	1,922	2,949	1,504	4,511
Stellako R.	136,709	185,641	322,711	147,189
QUESNEL				
Horsefly R.	467,640	743,122	*2,039,959* *1*	106,714
Horsefly Channel	19,597	24,934	- *1*	19,599
McKinley Cr.	35,747	75,829	- *1*	3,007
Mitchell R.	124,148	299,920	969,571	22,163
Miscellaneous	12,367	35,447	52,621	18,285
Quesnel Total	659,499	1,179,252	3,062,151	169,768
CHILCOTIN				
Chilko R. & L.	448,815	879,010	382,753 *2*	468,947
Chilko Channel	1,930	- *1*	-	- *3*
SETON-ANDERSON				
Gates Cr.	0	936	222	0
Gates Channel	3,411	6,312	1,951	2,858
Portage Cr.	9,270	25,179	14,953	18,882
NORTH THOMPSON				
North Thompson R.	0	0	4,862	21,692
Raft R.	1,712	7,198	18,369	6,073
Fennell Cr.	5,919	8,741	7,198	11,117
Miscellaneous	40	9	1,137	4,199
SOUTH THOMPSON				
Early Summer-run				
Scotch Cr.	73,180	35,981	101,269	144,199
Seymour R.	64,038	34,048	113,408	107,941
Anstey R.	7,380	4,741	20,034	9,490
Eagle R.	45,452	28,478	64,877	21,692
Miscellaneous	16,849	5,328	10,784	8,905
Late-run				
Adams R.	680,269	870,919	3,752,297	1,461,293
Adams Channel	2,031	0	5,224	13
Lower Shuswap R.	367,661	291,631	780,655	829,711
Middle Shuswap R.	31,806	15,262	106,064	71,348
Miscellaneous	288,910	211,459	888,023	535,344
Late S. Thompson Total	1,370,677	1,389,271	5,532,263	2,897,709
HARRISON-LILLOOET				
Birkenhead R.	39,234	295,669	*189,445* *1*	266,459
Big Silver Cr.	632	5,974	29,419	21,298
Harrison R.	9,515	4,496	41,542	168,259
Weaver Cr.	20,017	28,020	66,327	6,967
Weaver Channel	44,939	29,071	34,706	32,814
LOWER FRASER				
Nahatlatch R. & L.	6,042	7,993	7,305	1,678
Cultus L.	4,399	1,959	4,873	3,785 *4*
Upper Pitt R.	9,500	76,888	90,280	38,816
Chilliwack L./Dolly Varden Cr.	7,966	1,068	3,841	1,097
MISCELLANEOUS	589	1,389	6,004	6,156
ADULTS	3,099,689	4,422,075	10,202,514	4,661,459
JACKS	3,947	5,604	5,449	1,674
TOTAL NET ESCAPEMENT	3,103,636	4,427,679	10,207,963	4,663,133

* Estimates are from DFO.

1 Spawning ground escapement was not enumerated. Estimates, if shown, are projected escapements.

2 Includes Chilko Channel.

3 Chilko Channel not in operation.

4 Includes 276 sockeye removed for broodstock.

Table 4. Detailed calculation of total allowable catch and international catch allocation for Fraser River sockeye salmon by management group in 2006. In-season estimates of abundance, spawning escapement target, management adjustment and test fishing catch at the time the Panel relinquished control of the last U.S. Panel Area (September 30) were used, according to the revised Annex IV agreed to on Feb. 17, 2005.

TAC Calculations	Fraser Sockeye						
	Early Stuart	Early Summer	Summer	Birken -head	Late	Total	
RUN STATUS, ESCAPEMENT NEEDS & AVAILABLE SURPLUS							
In-season Abundance Estimate	**70,000**	**1,450,000**	**2,000,000**	**475,000**	**4,720,000**	**8,715,000**	
Spawning Escapement Target (SET)	**68,500**	**580,000**	**1,792,000**	**190,000**	**1,888,000**	**4,518,500**	
Management Adjustment (MA)	**na**	**294,000**	**36,000**	**0**	**1,227,000**	**1,557,000**	
Proportional MA (pMA)	2.47	0.5067	0.02	0	0.65		
Adjusted Spn. Esc. Target	68,500	874,000	1,828,000	190,000	3,115,000	6,075,500	
Test Fishing (TF)	**1,500**	**32,000**	**32,000**	**4,000**	**65,000**	**134,500**	
Surplus above Adjusted SET & TF	0	544,000	140,000	281,000	1,540,000	2,505,000	
DEDUCTIONS & TAC FOR INTERNATIONAL SHARING							
Aboriginal Fishery Exemption (AFE)	**0**	**45,200**	**292,500**	**2,200**	**60,100**	**400,000**	
Total Deductions (Adj.SET+TF+AFE)	70,000	951,200	2,152,500	196,200	3,240,100	6,610,000	
Available TAC	**0**	**499,000**	**0**	**279,000**	**1,480,000**	**2,258,000**	
UNITED STATES (Washington) TAC							
Proportionally Distributed TAC *	**0**	**82,000**	**0**	**46,000**	**244,000**	**373,000**	16.5%
Washington Catch	0	129,000	181,000	15,000	382,000	708,000	
Deviation from Proportionally Distributed TAC	0	-47,000	-181,000	31,000	-138,000	-335,000	
CANADA TAC							
Proportionally Distributed TAC		417,000	0	233,000	1,236,000	1,885,000	83.5%
AFE	0	45,200	292,500	2,200	60,100	400,000	
Canadian TAC + AFE	**0**	**462,000**	**293,000**	**235,000**	**1,296,000**	**2,285,000**	
Canadian Catch excluding ESSR Catch	6,000	644,000	1,141,000	170,000	2,604,000	4,565,000	
Deviation from Proportionally Distributed TAC	-6,000	-182,000	-848,000	65,000	-1,308,000	-2,280,000	
TOTAL							
Available TAC + AFE	**0**	**544,000**	**293,000**	**281,000**	**1,540,000**	**2,658,000**	
Total Catch	6,000	773,000	1,322,000	185,000	2,986,000	5,273,000	
Deviation from Proportionally Distributed TAC	-6,000	-229,000	-1,029,000	96,000	-1,446,000	-2,615,000	

* Washington sockeye share according to Annex IV of the Pacific Salmon Treaty.

APPENDIX K: STAFF OF THE PACIFIC SALMON COMMISSION IN 2006

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

BIOMETRICS GROUP

Ian Guthrie, Head

STOCK IDENTIFICATION GROUP

Jim Gable, Head
Holly Anozie, Scale Lab Assistant
Steve Latham, Sockeye Stock Identification Biologist
Maxine Reichardt, Senior Scale Analyst
Julie Sellars, Assistant Scale Analyst
Bruce White, Pink Stock Identification Biologist

STOCK MONITORING GROUP

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

APPENDIX L: MEMBERSHIP OF THE FRASER RIVER PANEL TECHNICAL COMMITTEE IN 2006

2006 Technical Committee Members	
United States	**Canada**
G. Graves, Co-Chair *Northwest Indian Fisheries Commission*	L. Jantz, Co-Chair *Fisheries and Oceans Canada*
K. Adicks *Washington Department of Fish and Wildlife*	A. Cass *Fisheries and Oceans Canada*
S. McAvinchey *National Marine Fisheries Service*	R. Goruk *Fisheries and Oceans Canada*
	J. Grout *Fisheries and Oceans Canada*
	M. Staley *First Nations Advisor*