
**Report of the
Fraser River Panel
to the
Pacific Salmon Commission
on the
1993 Fraser River Sockeye and
Pink Salmon Fishing Season**



Prepared by the
Pacific Salmon Commission
August, 1996

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**REPORT OF THE
FRASER RIVER PANEL
TO THE PACIFIC SALMON COMMISSION
ON THE 1993 FRASER RIVER SOCKEYE AND PINK
SALMON FISHING SEASON**

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August, 1996

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I. EXECUTIVE SUMMARY

1. The Fraser River Panel managed fisheries in 1993 under the terms of a June 24, 1993 agreement between Canada and the United States. The agreement limited United States catches of Fraser River sockeye and pink salmon in the Panel Area to shares of the Total Allowable Catches (TAC's) following defined formulas. It was agreed that United States fisheries would not target on Early Stuart sockeye, while United States catches of early summer-, summer- and late-run sockeye were to be in proportion to the TAC of these stocks. Catches of Fraser sockeye in Alaska were excluded from the sharing formula, but were still to be included in overall accounting.
2. Pre-season forecasts were for a run size of 17,360,000 Fraser River sockeye salmon and a TAC of 12,062,000 sockeye. Forecasts of run size and TAC of Fraser River pink salmon were 31,000,000 and 21,450,000 fish, respectively.
3. Canada set pre-season net escapement goals of 3,745,000 adult Fraser sockeye and 9,500,000 pink salmon. Gross escapement goals, provided on July 9, were 545,000 Early Stuart, 204,000 early summer-run, 3,735,000 summer-run and 226,000 late-run sockeye, for a total of 4,710,000 adult sockeye. The gross escapement goal for Fraser pinks was the same as the net escapement goal since small Indian fishery catches were anticipated.
4. Expected United States shares, based on forecast run sizes and TAC's, were 2,412,000 Fraser sockeye and 3,600,000 Fraser pinks. A tiered plan allocated Washington fishers 20% of the sockeye TAC below 12,062,000, 10% of the TAC between 12,062,000-15,000,000, and 5% of the TAC between 15,000,000-17,000,000, to a maximum of 2,806,000 Fraser sockeye. The allocation of Fraser pinks was 25.7% of the TAC, to a maximum of 3,600,000 fish.
5. Although the U.S. had a domestic allocation plan for sockeye that deviated from the normal 50:50 split between Treaty Indian and Non-Indians for a narrow range of TAC's, the goal used by the Panel for pre-season planning purposes was for a 50:50 split between Treaty Indian and Non-Indian catches in Washington. Treaty Indians in Areas 4B, 5 and 6C were allocated 100,000 fish, with the balance of the Treaty Indian share to be caught in Areas 6, 7 and 7A. Non-Indian catches were to be split among gear types: 54% for seines, 41% for gillnets and 5% for reefnets. United States catches of pink salmon were also to be divided equally between Treaty Indians and Non-Indians. Within the Non-Indian share, commercial trollers in Areas 3 and 4 had a harvest quota of 120,000 Fraser pinks.
6. The Canadian share of the forecast run was 10,601,000 Fraser sockeye, which included a Canadian Escapement Add-on Benefit of 951,000 fish from escapement add-ons in 1989. The estimated Canadian share of Fraser River pink salmon was 17,850,000 fish.
7. Canadian domestic allocation goals for Fraser River sockeye salmon were to be calculated using a tiered scheme, with each gear allocated a percentage of the first 8,300,000 sockeye caught and a different percentage of catches exceeding this amount. In addition, there was a payback from purse seines to the other gear types to compensate for catch shortfalls in previous years. The allocation of southerly migrating pink salmon was: purse seines - 58%; outside trollers - 29%; gillnets - 9%; and inside trollers - 4%.
8. The Fraser River Panel established a fishery regime and a pre-season management plan based on forecast run sizes and migration timing; a Johnstone Strait diversion rate of 52%; goals for catch and escapement; and conservation concerns for other species and stocks of salmon identified by the Parties. The peak Juan de Fuca Strait (Area 20) migration of the major sockeye stocks, Quesnel and Late Stuart, was expected to be on August 18. Fraser River pink

salmon were expected to peak on August 25. Forecast migration percentages through Johnstone Strait were 73% for Fraser sockeye and 30% for Fraser pinks.

9. To ensure that the various goals were achieved, the Panel met frequently (28 times) throughout the fishing season to enact regulations for Panel Area fisheries. Numerous meetings were necessary because of the complex allocation goals and because in-season estimates of catches and run parameters deviated widely from pre-season forecasts and, in some cases, varied considerably from week to week.
10. The total return of Fraser River sockeye salmon was 24,195,000 fish, 6,835,000 fish more than forecast and the largest return on any cycle since 1913. For Fraser River pink salmon, the run of 17,009,000 fish was slightly larger than the average since 1979, but only 55% of the forecast 31,000,000 fish.
11. Catches of Fraser sockeye totalled 17,768,000 fish, 16,621,000 in commercial fisheries, 1,033,000 in Canadian Indian fisheries and 114,000 in other fisheries. Canadian commercial fishers caught 13,747,000 sockeye while United States fishers caught 2,692,000 in United States Panel Areas and 182,000 in Alaska fisheries. Fraser pink catches were 6,002,000 fish in commercial and 232,000 in non-commercial fisheries, for a total of 6,234,000 fish. Commercial catches in Canada and the United States were 4,242,000 and 1,760,000 pinks, respectively. Included in the non-commercial catch were recreational catches of 145,000 pinks in Canada and 40,000 in Washington, Fraser River Indian catches of 17,000 fish and test fishing catches of 30,000 pinks.
12. The Stock Monitoring program provided in-season estimates of abundance, run timing and migration route proportions of Fraser River sockeye and pink stocks throughout the fishing season. Management difficulties were encountered because of many factors: effects of unusual run timing on estimating the abundance of Early Stuart sockeye; the late arrival, very high diversion rate and large run of summer-run stocks through Johnstone Strait; and the late arrival, lower than expected run strength and high diversion of Fraser River pink salmon through Johnstone Strait. The diversion rate of sockeye salmon (70%) through Johnstone Strait was close to the forecast (73%), but the rate for pink salmon (64%) was about double the forecast (30%). Both rates were much higher than the long-term averages (25% for sockeye and 30% for pink salmon).
13. In-season estimates of gross escapement past Mission, based on hydroacoustic and test fishing catch-per-unit-effort data and including Fraser River Indian catches below Mission, totalled 5,717,000 sockeye and 3,849,000 pink salmon. The sockeye estimate is lower than Canada Department of Fisheries and Oceans' estimate of 7,249,000 adults on the spawning grounds and in Indian catches in the river. The estimate for pink salmon escapement is much less than Canada's estimate of 10,792,000 fish based on spawning ground enumerations and Fraser River Indian catches.
14. The Racial Analysis program was successful in using scale and other characteristics to identify the major stock groups of Fraser River sockeye throughout the season, except for difficulties distinguishing Chilko sockeye from the dominant summer-run stocks (Quesnel and Late Stuart). Genetic Stock Identification methods were used to identify Fraser River and other southerly migrating pink salmon stocks in mixed-stock fisheries.
15. Spawning escapement estimates by Canada Department of Fisheries and Oceans totalled 6,402,000 adult and 25,000 jack Fraser sockeye and 10,775,000 pink salmon. The sockeye spawning escapement was the largest since 1909.
16. Gross escapement goals for Fraser River sockeye and pink salmon were adjusted during the season to the final goals of 5,554,000 adult sockeye and 6,105,000 pink salmon. Using DFO's

- preliminary spawning escapement and Indian catch estimates, gross escapements were 457,000 more than the goal for Early Stuart sockeye, 60,000 under for early summer-run stocks, 1,536,000 over for summer-run stocks and 238,000 under for late-run sockeye, for a total of 1,695,000 fish over the goal. DFO's estimate of pink salmon escapement (10,775,000 fish) was almost twice the goal and three times the in-season estimate.
17. The preliminary estimate of the TAC in 1993 is 15,993,000 Fraser River sockeye salmon, based on a run size of 24,195,000 fish, a Canadian Escapement Add-on Benefit of 1,285,000 and other deductions (including net escapements, the Fraser River Indian fishery exemption of 400,000, and test fishing catches) totalling 6,917,000 fish. For Fraser River pink salmon, the run size, deductions and TAC are estimated to be 17,009,000, 10,805,000 and 6,204,000, respectively.
 18. Catches of Fraser River sockeye salmon in United States Panel Area fisheries totalled 2,692,000 fish, 64,000 less than the goal of 2,756,000 Fraser sockeye. Including the Alaska catch of 182,000, the total United States catch was 2,874,000 Fraser sockeye. United States Panel Area catches of early summer-run, summer-run and late-run sockeye were 29,000 over, 63,000 under and 30,000 fish under the goals, respectively. United States catches of Fraser River pink salmon totalled 1,800,000 fish, 205,000 over the goal of 1,595,000 fish.
 19. With respect to United States Panel Area domestic allocations of Fraser sockeye, Treaty Indians and Non-Indians were 30,000 fish over and 30,000 fish under the respective goals. Within the Treaty Indian group, the catch in Areas 4B, 5 and 6C was 53,000 fish less than the goal while in Areas 6, 7 and 7A the catch was over by 53,000 fish. Non-Indian gillnets, purse seines and reefnets, respectively, caught 46,000 under, 16,000 over and 30,000 over their allocations. Treaty Indians were 17,000 under the catch goal for Fraser River pink salmon, while Non-Indians were over by 17,000 fish.
 20. In Canada, gillnets exceeded the domestic allocations of Fraser River sockeye salmon by 958,000 fish. Outside trollers, purse seines and inside trollers were 593,000, 364,000 and 1,000 fish under. For allocations of southerly migrating pink salmon, purse seines were 185,000 over, inside trollers were 105,000 over, gillnets were 75,000 under and outside trollers were 215,000 under.
 21. There were no major conflicts between the harvest of Fraser River sockeye salmon and the conservation of other species and stocks in 1993. Concerns identified by Canadian and United States agencies were taken into account during the design and implementation of the fishing plans. The planned closure of Canada's Area 29 after September 8 for the protection of Harrison River chinook stocks was relaxed to allow fisheries at times of low abundances of these stocks. Catches of non-target species was low or modest in all areas.

II. FRASER RIVER PANEL

Under the Pacific Salmon Treaty, the Fraser River Panel is responsible for in-season management of fisheries that harvest Fraser River sockeye and pink salmon within the Panel Area (Figure 1). Prior to the onset of the fishing season, the Panel recommends a fishing regime and a management plan for Panel Area fisheries to the Pacific Salmon Commission (PSC). The pre-season plan is based on 1) abundance and timing forecasts and escapement goals for Fraser River sockeye and pink salmon stocks provided by Canada Department of Fisheries and Oceans (DFO), 2) international allocation goals set by the Treaty, 3) domestic allocation goals set by each country, 4) management concerns for other stocks and species identified by each country, and 5) historic migration patterns and fisheries dynamics. The objectives that guide the Panel's decision making both before and during the fishing season are, in descending priority, to achieve the goals for gross escapement, international allocation and domestic allocation, and to address the Parties concerns for other species and stocks.

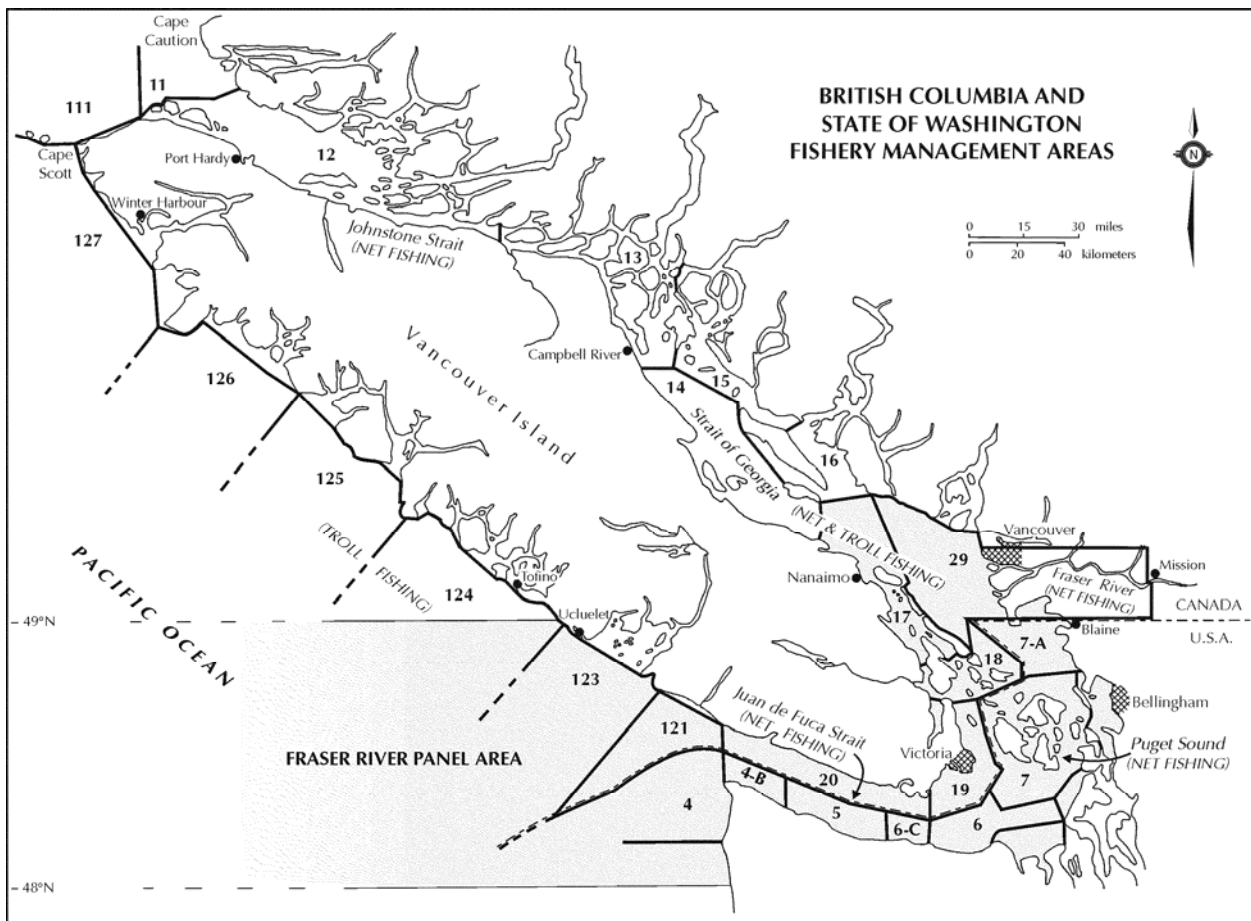


Figure 1. Fishery management areas and commercial gear used in the Fraser River Panel Area and Canadian south coast waters.

The pre-season management plan adopted by the PSC specifies a management scenario that is likely to achieve the goals, given the pre-season expectations. Using in-season commercial and test fishing data and various analyses from PSC staff, the Panel modifies the fishing times stated in the management plan to respond to deviations from pre-season expectations.

The activities of the Panel are facilitated by the Fraser River Panel Technical Committee, who provide the Panel with data and technical advice.

In 1993, the Panel exercised its regulatory mandate in the Panel Area only for net fisheries, the Canadian inside (Strait of Georgia) troll fishery and the Washington Non-Indian coastal troll fishery. Development of management plans for other species and stocks intercepted in south coast regions is the responsibility of the Southern Panel and the Commission, with actual management in each region the responsibility of the appropriate country.

Input to the decision making process occurs primarily through the national sections of the Panel where most user groups are represented. The Panel membership and their affiliations during the 1993 season were:

CANADA	UNITED STATES
Members	
Mr. A. Lill, Chair Department of Fisheries and Oceans	Mr. D. Austin, Vice-Chair Washington Department of Fisheries
Mr. E. Crey Fraser River Indian fishermen	Ms. L. Loomis Treaty Indian tribes
Mr. M. Forrest Gillnet fishermen	Mr. R. Schmitten National Marine Fisheries Service
Ms. R. Kendall Freshwater sport fishermen	Mr. R. Zuanich Commercial salmon fishing industry
Mr. L. Wick Purse seine fishermen	
Alternates	
Mr. V. Fiamengo Purse seine fishermen	Mr. R. Allen Treaty Indian tribes
Mr. M. Griswold Gulf troll fishermen	Ms. T. Clocksin Washington Department of Fisheries
Ms. K. McGivney Department of Fisheries and Oceans	Mr. B. Robinson National Marine Fisheries Service
Mr. M. Medenwaldt Outside troll fishermen	Mr. B. Suggs Commercial salmon fishing industry
Mr. R. Nugent Gillnet fishermen	

III. INTRODUCTION

In 1913, fisheries in Fraser River and Puget Sound areas harvested more than 32,000,000 sockeye. This huge catch, the largest on record, was taken from the second largest run since estimates began in 1893 (Figure 2). The very large escapement associated with this run (over 6,000,000 sockeye) was decimated at Hells Gate in the Fraser Canyon, however, because rock debris from railway construction had been dumped into the river. The resulting constriction in river flow made Hells Gate virtually impassable, so millions of sockeye died without spawning. The blockage, combined with the adverse affects of dams on the Quesnel and Lower Adams Rivers and over-fishing in subsequent years, caused runs on this cycle to plummet from a pre-1913 average of over 33,000,000 sockeye to a low of 1,900,000 in 1921 and an average of 3,600,000 for the 1917-1929 period. Spawning escapements on this cycle remained very low between 1921 and 1937, with estimates ranging from 180,000 to 680,000. This historically dominant cycle of Fraser River sockeye salmon was thus reduced to the much lower levels of the other three cycles.

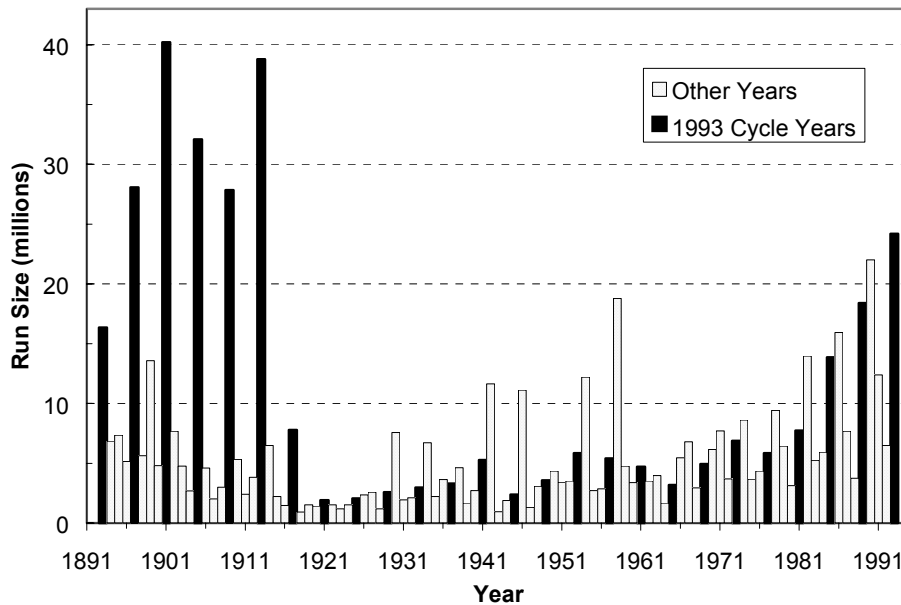


Figure 2. Total run sizes of Fraser River sockeye salmon between 1893-1993. Returns on the 1993 cycle are highlighted.

In 1993, the return of Fraser River sockeye salmon was the largest (24,195,000 fish) since the Hells Gate disaster 80 years earlier (Figure 2). One of the dominant stock groups in 1913, i.e., Quesnel Lake area sockeye (Horsefly River), was the major contributor in 1993, totalling over 12,000,000 fish. Recovery of Quesnel sockeye has been remarkable. In 1941, a small return of only 12,000 fish faced intense fishing pressure and another serious blockage at Hells Gate. Only 1,000 adult sockeye survived to spawn in the Quesnel Lake system. From that small nucleus, returns on the 1993 cycle have grown to where this run is now the largest in the Fraser watershed, just surpassing the Adams/Lower Shuswap run which predominated since the 1930's. Returns of Quesnel stocks over the past eight years have totalled 28,302,000 fish compared to 26,290,000 Adams/Lower Shuswap fish. The 1993 spawning escapement of Quesnel stocks (2,592,000 adults) was the highest since 1909.

Growth of returns to the Quesnel River system has been achieved as a result of substantial effort and investment. Canada and the United States funded the International Pacific Salmon Fisheries Commission's construction of fishways in the Fraser Canyon from 1944 to 1966, which allowed sockeye salmon unobstructed access to upriver spawning areas, including areas in the Quesnel watershed. As well, restricted fisheries on summer-run stocks between 1946 and 1950 helped to increase the numbers of spawners. Greater returns were quickly realized, but extensive pre-spawning mortality of early-arriving fish in the mid 1960's (as high as 65%) slowed rebuilding efforts. In the late 1970's and 1980's, harvests were regulated to selectively increase the escapement of later-timed stocks that spawn in the lower Horsefly River and Mitchell River. Canada has continued to invest in this stock with increases to escapement since 1985 and the construction of a spawning channel in 1989. As a result of these long-term efforts, large escapements in 1993 occupied all spawning areas in the upper and lower Horsefly River as well as in Mitchell River. The Quesnel run has clearly recovered a significant portion of its productive capacity. The question now is: how large a population can be accommodated by the available spawning grounds and lake rearing areas? Research is being conducted by DFO to determine the productive capacity for sockeye in the Quesnel River system, since current levels of spawning escapement are near or beyond historic peaks.

Along with the strong return of Quesnel stocks in 1993, there were record returns and escapements of Late Stuart sockeye and, for this cycle, of Chilko River sockeye. Good production from Early Stuart, Birkenhead and Weaver stocks also added significantly to the total return.

Management of Fraser River sockeye salmon fisheries in 1993 presented unique problems to the Panel. Foremost among these were a combination of large catch requirements for both Parties and a very high diversion of 70% of Fraser sockeye through Johnstone Strait. The high diversion was related to warm ocean waters resulting from an El Nino event in 1993 (1992 was also an El Nino event). Intense fishing in United States waters over a four-week period was required to achieve the international allocation of the Total Available Catch (TAC). At the same time, over 80% of the British Columbia purse seine fleet converged on Johnstone Strait fishing areas in August and fished on the peak of the run in two consecutive weeks. Emergency closures by DFO were required to allow an adequate escapement and to meet the goals for domestic allocation of sockeye among gear types in Canada. Also, requirements for Fraser River Indian fisheries throughout the season created difficulties in scheduling lower Fraser commercial fisheries. The achievement of most escapement and catch goals is a testimony to the value of co-operative international management efforts.

Pink salmon returns since 1979 have been substantially higher than in the previous ten cycles (1959-1977, Figure 3). The estimate of the 1993 Fraser River pink salmon run is 17,009,000 fish, which includes DFO's estimate of 10,775,000 spawners in the Fraser watershed.

The Johnstone Strait migration of Fraser pink salmon (64%) in 1993 was very high (compared to the long-term average of 33%), similar to sockeye salmon. Only in 1983 was the proportion as great. Both 1983 and 1993 were El Nino years, which strongly suggests that El Nino events have major impacts on pink salmon migration, as they do on sockeye migration.

Fisheries in Johnstone Strait were closed during the peak of the pink salmon migration (August 22-28). Low commercial catches in the weeks preceding and following the closure and modest test fishing catches within a week of the closure indicated low abundance. Thus, although spawning ground estimates now indicate a large escapement occurred, these fish were not apparent from the catches taken during the season. Similarly, the Mission estimate of gross escapement (3,849,000 pinks) was only one-third the spawning ground estimate (10,775,000 fish). Fisheries for Fraser River pink salmon in 1993 were affected by conservation requirements for the latter portion of the sockeye run.

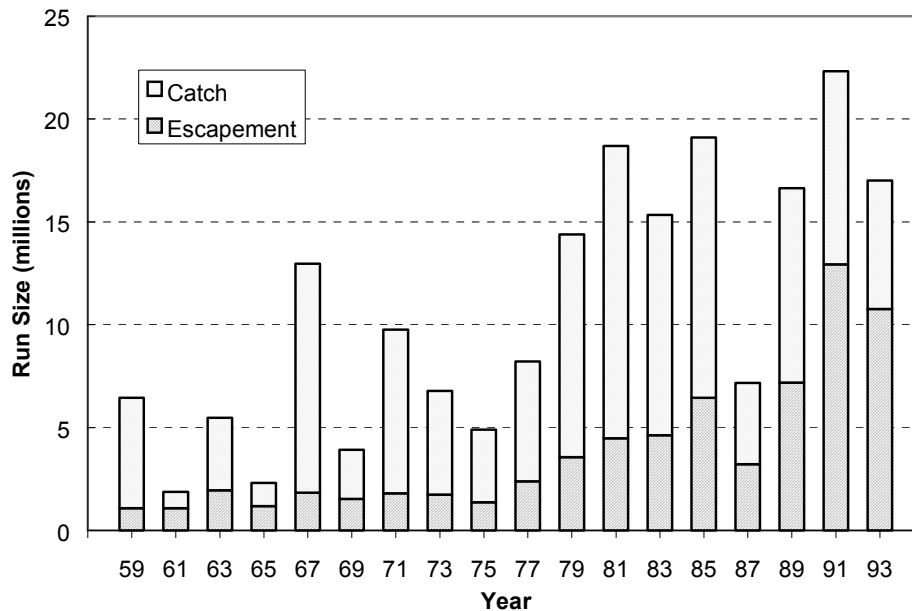


Figure 3. Catch, escapement and total returns of Fraser River pink salmon for odd years between 1959-1993.

IV. MANAGEMENT ACTIONS

A. Pre-season Forecasts, Goals and TAC

Canada provided the Panel with run-size forecasts and spawning escapement goals for Fraser River sockeye and pink salmon stocks in January, 1993 (Appendix A). These goals were revised on June 11 (Table 1). Gross escapement goals (Table 1) for sockeye salmon were provided by Canada on July 9. The forecast return of Fraser River sockeye salmon was 17,360,000 fish (including 247,000 jacks), with a net escapement goal of 3,872,000 (including 127,000 jacks) and a projected catch of 13,488,000 sockeye. For Fraser River pink salmon, the forecast return of 31,000,000 fish was expected to provide for an escapement goal of 9,500,000 and projected catch of 21,500,000 fish.

The Parties agreed on a harvest sharing formula (Table 2) and management plan for the 1993 fishing season on June 24, 1993, well after the usual timing in previous years. The maximum shares available to United States Panel Area fisheries would be 2,806,000 Fraser sockeye and 3,600,000 Fraser pinks, which would be generated at TAC's of 17,000,000 sockeye and 14,008,000 pink salmon, respectively. In addition, the Parties agreed that 1) the sharing formula for sockeye applied only to Panel areas (i.e., Alaska catches would be accounted but not included in the United States share), and 2) the United States would not fish on the Early Stuart run, to provide adequate escapements for spawning and Fraser River Indian fisheries.

Table 1. Pre-season gross and spawning escapement goals and forecasts of run sizes and catches of Fraser River sockeye and pink salmon in 1993.

Run	River & Ocean Catch *	Fraser Indian Catch	Goals		Total Run
			Spawning Escapement	Gross ** Escapement	
Sockeye Salmon					
Early Stuart	255,000	245,000	300,000	545,000	800,000
Early Summer	229,000	64,000	140,000	204,000	433,000
Summer	11,615,000	620,000	3,115,000	3,735,000	15,350,000
Late	<u>304,000</u>	<u>36,000</u>	<u>190,000</u>	<u>226,000</u>	<u>530,000</u>
Total Adults	12,403,000	965,000	3,745,000	4,710,000	17,113,000
Jacks	<u>120,000</u>	<u>0</u>	<u>127,000</u>	<u>127,000</u>	<u>247,000</u>
Total Sockeye	12,523,000	965,000	3,872,000	4,837,000	17,360,000
Pink Salmon					
Total Pink Salmon	21,500,000	0	9,500,000	9,500,000	31,000,000

* Includes catches in commercial, test, and other fisheries, excluding Fraser River Indian fisheries.
 ** Gross escapement = Fraser River Indian catch + spawning escapement

Table 2. Rules for calculating United States Panel Area shares of Fraser River sockeye and pink salmon in 1993, from the June 24, 1993, agreement between the Parties.

TAC Range		Washington Share *		
Minimum	Maximum	Base	Incremental %	Maximum
Sockeye				
0	12,062,000	0	20%	2,412,000
12,062,000	15,000,000	2,412,000	10%	2,706,000
15,000,000	17,000,000	2,706,000	5%	2,806,000
17,000,000	...	2,806,000	0%	2,806,000
Pink				
0	14,008,000	0	25.7%	3,600,000
14,008,000	...	3,600,000	0%	3,600,000

* Share for a given TAC = Base share + (Incremental % x (Actual TAC - Minimum TAC))

The expected TAC's were 12,062,000 sockeye and 21,450,000 Fraser River pink salmon (Table 3). Forecast catch goals for Washington fishers were 2,412,000 sockeye and 3,600,000 pink salmon, leaving Canadian shares of 10,601,000 sockeye and 17,850,000 pink salmon. Canada's sockeye share included an add-on benefit of 951,000 fish, for allowing additional fish from their 1989 allocation to spawn.

United States catches of early summer-, summer- and late-run sockeye were to be in proportion to the TAC's of these groups. Anticipated United States catches were 55,000 early summer-, 2,278,000 summer- and 79,000 late-run sockeye.

Table 3. Pre-season estimates of the total allowable catch (TAC), and United States Panel Area and Canadian shares of Fraser River sockeye and pink salmon in 1993.

	<u>Sockeye</u>	<u>Pink</u>
TOTAL ALLOWABLE CATCH		
Total Run Size	17,360,000	31,000,000
Canadian <u>Add-on Escapement Benefit</u>	<u>951,000</u> *	<u>0</u>
Total Available to Share:	16,409,000	31,000,000
Deductions		
Adult Escapement Goal	3,745,000	9,500,000
Jack Escapement	127,000	0
Fraser River Indian Food Fishery Exemption	400,000	0
Test Fishing	<u>75,000</u>	<u>50,000</u>
<u>Total Deductions</u>	<u>4,347,000</u>	<u>9,550,000</u>
Total Allowable Catch:	12,062,000	21,450,000
UNITED STATES		
Washington Share **:	2,412,000	3,600,000
CANADA		
TAC - United States Share	9,650,000	17,850,000
Escapement <u>Add-on Benefit</u>	<u>951,000</u> *	<u>0</u>
Canadian Share:	<u>10,601,000</u>	<u>17,850,000</u>

* Method of calculation agreed-to by Fraser River Panel on February 8, 1991 and June 24, 1993.

** Washington shares according to agreement between the Parties on June 24, 1993.

Sockeye: (20% of TAC below 12,062,000) + (10% of TAC between 12,062,000 and 15,000,000) + (5% of TAC above 15,000,000), to a maximum of 2,806,000.

Pink: 25.7% of TAC, to a maximum of 3,600,000.

Canadian domestic allocation goals for Fraser River sockeye salmon are shown in Table 4. Each commercial gear was allocated a percentage of the first 8,300,000 sockeye caught (base catch) and a different percentage for catches exceeding this number (incremental catch). Also, the allocations were adjusted to account for overages and underages in past years' sockeye catches. In 1993, purse seines were owed a total of 386,000 sockeye by the other gear. However, the maximum amount that each gear would be required to pay back was limited to 10% of its allocation (base plus incremental), so the total amount to be paid back in 1993 would likely be less than 386,000 fish, based on pre-season forecasts.

The Canadian allocation of southerly migrating pink salmon among the commercial gear types was 4% for inside troll, 29% for outside troll, 58% for purse seine and 9% for gillnet. No specific goals were set for catches of Fraser River pink salmon.

For domestic allocation of Washington catches, the goal used by the Panel for planning purposes was a 50:50 split between Treaty Indians and Non-Indians. Treaty Indians in Areas 4B, 5 and 6C (Figure 1) were allocated 100,000 fish, with the balance of the Treaty Indian share to be caught in Areas 6, 7 and 7A. Non-Indian catches were to be split among gear types: 54% for seines, 41% for gillnets and 5% for reefnets. United States catches of pink salmon were also to be divided equally between Treaty Indians and Non-Indians. Within the Non-Indian share, commercial trollers in Areas 3 and 4 (west coast of Washington) had a harvest quota of 120,000 Fraser pinks.

Table 4. Domestic allocation plan for Canadian commercial catches of Fraser River sockeye and southerly migrating pink salmon in 1993. Overages and underages in previous years are used to calculate payback amounts.

Gear Type	Fraser River Sockeye Salmon			Southerly Migrating Pink Salmon Allocation
	Allocation		Overage (Underage) ***	
	Base Catch *	Incremental Catch **		
Inside Troll	2.0%	5.0%	26,000	4.0%
Outside Troll	10.0%	30.0%	348,000	29.0%
Purse Seine	55.0%	42.0%	(386,000)	58.0%
Gillnet	33.0%	23.0%	12,000	9.0%
Total	100.0%	100.0%	0	100.0%

* Base catch: First 8,300,000 sockeye in Canadian commercial catch.

** Incremental catch: Canadian commercial catch in excess of the base catch.

*** The payback amount in a given year is the cumulative overage by a gear, to a maximum of 10% of the gear's allocation (base + incremental).

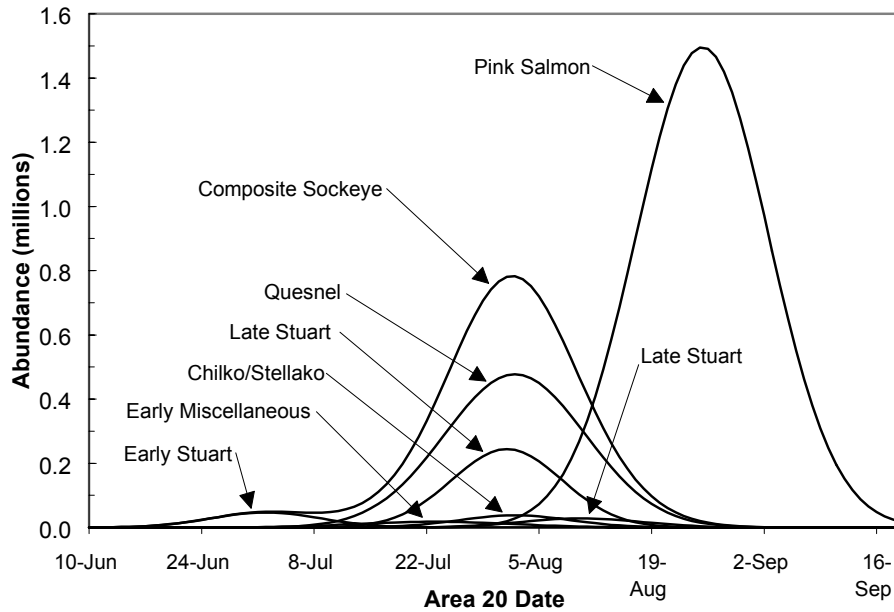


Figure 4. Pre-season expectations of the timing and abundance of migrating Fraser River sockeye and pink salmon through Area 20 in 1993.

B. Pre-season Regulations

The 1993 Regulations and Management Plan for the Panel Area were developed to achieve the catch and escapement goals described above. The timing and sequence of the proposed fisheries in the Plan were determined using the pre-season forecasts for run sizes (Appendix A) and timing (Figure 4). Usually, the pre-season forecast of diversion through Johnstone Strait (Figure 5) is also used. However, in 1993 a value of 52% diversion was used because of concern that the forecast 73% would not occur. These data were inputs for the fishery simulation model used to evaluate the impacts of management options on the goals of the Panel. The major targets of this year's sockeye fishery, the Quesnel and Late Stuart stocks, were expected to peak in Area

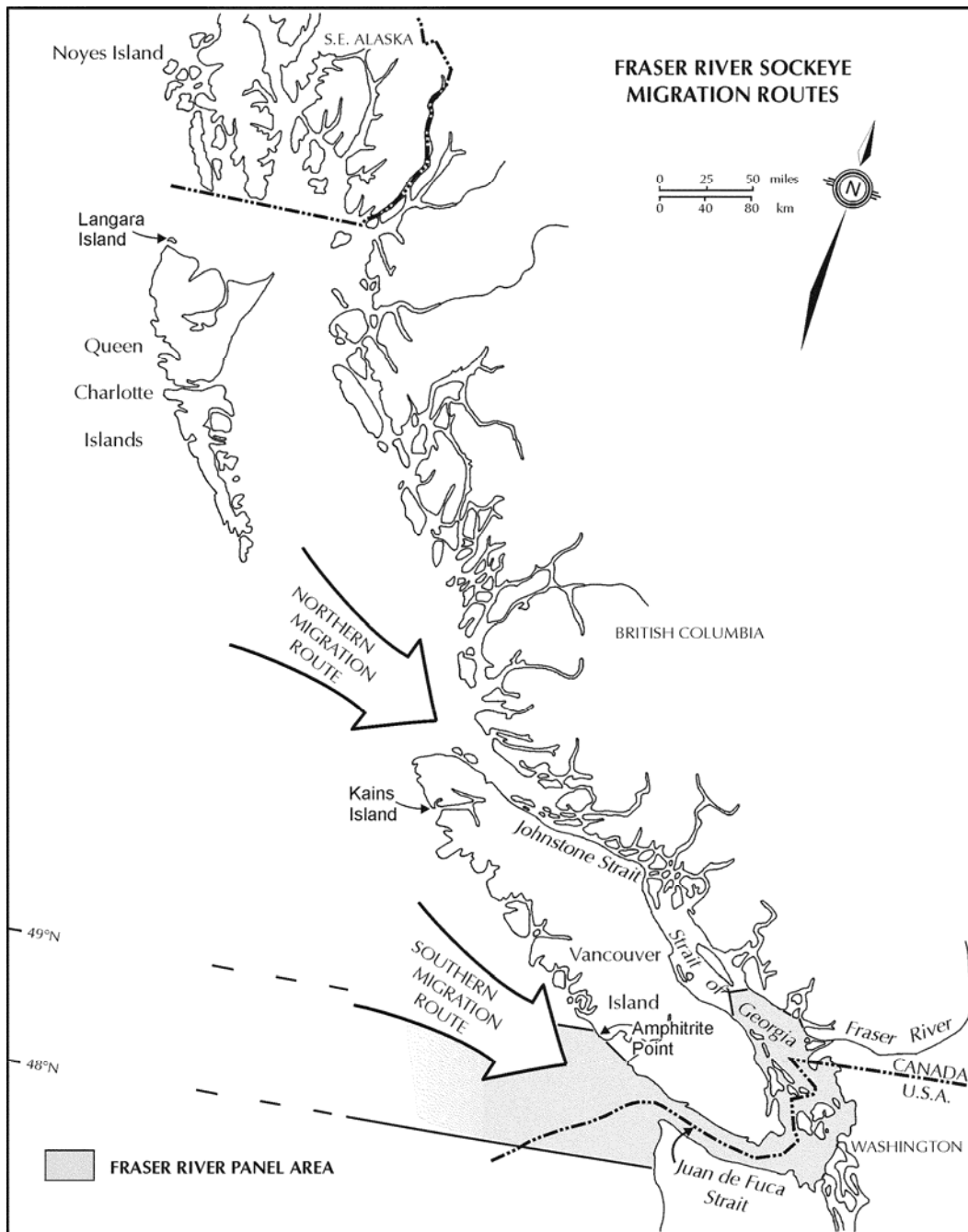


Figure 5. The northern (Johnstone Strait) and southern (Juan de Fuca Strait) routes for sockeye and pink salmon migrating to the Fraser River.

20 about August 18. These stocks were expected to comprise about 87% of the total catch of Fraser sockeye in 1993. The forecasts for Fraser River pink salmon were for an Area 20 peak migration date of about August 25 and a diversion rate of 30%.

The United States submitted a fishing schedule for the Non-Indian commercial troll fishery for pink salmon in Areas 3 and 4 on June 24. This plan specified a harvest quota of 120,000 Fraser River pinks and catch guidelines of 26,400 coho and 3,100 chinook salmon. The fishery was to close when the pink catch quota was achieved or when the coho or chinook catch guidelines were reached.

Both Canada and the United States identified stocks for which conservation or management concerns existed. Stocks identified by the United States included wild coho and chinook salmon generally and Skagit River and Lake Washington sockeye. Canada identified concerns for Harrison River and lower Strait of Georgia chinook salmon stocks, Thompson River steelhead stocks, and "study area" pink salmon stocks. The Management Plan accommodated these concerns in the following ways:

1. To protect Lake Washington and Skagit River sockeye runs, commercial fisheries in United States Areas 4B, 5, and 6C and Canadian Area 20 were to remain closed during their migration, which corresponds to the migration of Early Stuart sockeye through these areas.
2. To address United States and Canadian concerns, the by-catch of coho and chinook salmon was to be monitored in Panel Area fisheries and reported in-season.
3. Areas 4B, 5 and 6C were to be closed to Non-Indian net fishing after August 20 and to Treaty Indian net fishing after September 5 to minimize the by-catch of coho salmon.
4. Non-Indian gillnet and seine fisheries in Areas 7 and 7A were to be closed after August 31 to reduce the coho by-catch, unless the by-catch was less than the maximum agreed to within the pre-season planning process of the United States Pacific Fishery Management Council. The reefnet fishery could extend beyond this date with live release of coho required.
5. Area 6A was closed throughout the season to protect Skagit River sockeye, natural coho and summer chinook salmon, Stillaguamish River coho and chinook salmon and Snohomish River chinook salmon.
6. To protect Harrison River chinook and Thompson River steelhead, sockeye fisheries in Area 29 were to be completed by September 8.

On July 16, the Panel adopted a fishery regime (Appendix B) for regulatory control of the Panel Areas. The Commission accepted the regulations and submitted them to the Parties. As in previous years, fisheries regulated by the Panel were to be "Closed Unless Opened" by in-season Orders of the Panel.

The Panel finalized the pre-season Management Plan for 1993 on July 15. The proposed first openings for fisheries in Canadian Panel Areas were the week of July 25-31 for net fisheries in Areas 20 and 29, and August 1-7 for trollers in Areas 18-1, 18-4, 18-11 and 29.

Proposed first openings of Treaty Indian fisheries in United States Panel Areas were the week of July 18-24 for Areas 4B, 5 and 6C and July 25-31 in Areas 6, 7 and 7A. For Non-Indian fisheries the dates were July 25-31 in Areas 6, 7 and 7A and August 8 for troll fishing in Areas 3 and 4.

C. In-season Regulations

Between July 2 and September 14, the Fraser River Panel conferred 28 times (by telephone or in-person) to enact in-season orders (Appendix C) to regulate the fisheries on Fraser River sockeye and pink salmon in the Panel Area.

Some features of the 1993 fishing season that complicated the management of fisheries were 1) a Johnstone Strait run of Fraser sockeye (16,000,000 fish) that was double the previous record (7,900,000 fish), 2) an extremely high diversion rate (70% compared to a normal 25%), 3) the late arrival of summer-run sockeye stocks, and 4) unprecedented large catches of Fraser sockeye in northern Canadian fisheries. These features reduced the reliability of in-season run-size models normally used by Commission staff because they deviated so drastically from historic records upon which the models were based. Other unexpected aspects were an Early Stuart run that appeared to be half the forecast abundance (800,000), and a Fraser pink run that was estimated in-season to be only 37% of the forecast (31,000,000).

The following paragraphs summarize the events of the season on a weekly basis, with an emphasis on Panel decisions and rationale.

During the first in-season meeting on July 2, staff reported that the Early Stuart run appeared to be late and smaller than forecast. The data supporting this conclusion were a high proportion of age 5₂ fish in test fishing catches, relatively low escapement past Mission, and poor condition factor (low weight for given length of fish) of the fish.

On July 9, the Early Stuart run size was reduced to 400,000, half of the pre-season forecast of 800,000 fish. As a consequence, gross and net escapement goals for this stock were reduced to 400,000 and 250,000 fish, respectively, in accordance with a schedule provided by Canada on July 9. Also on July 9, Canada provided a diversion rate forecast of 73% and gross escapement goals by run: 204,000 early summer-, 3,735,000 summer- and 226,000 late-run sockeye (Table 1).

The Early Stuart run-size estimate was subsequently increased to 500,000 on July 13 and 600,000 on July 16. These increases resulted in a larger gross escapement goal of 494,000 fish. At this time the run appeared to be about five days late. To begin harvesting the available TAC, Area 29 was scheduled to open for gillnet fishing on July 19. Because of the Panel agreement that the United States would not fish the Early Stuart run, planned Treaty Indian fisheries in Areas 4B, 5 and 6C remained closed. To allow fisheries for other species to proceed, the Panel relinquished regulatory control of Canadian Area 18-4 and, between July 18-August 7, United States Areas 4 and 3 (north of 48° 00' 15" N).

During the week of July 18-24, Canada provided a forecast that summer-run stocks would be three weeks later than usual. During this week, it became apparent that the Early Stuart migration curve was flatter than usual and the peak of the run about 10 days late, so previous estimates of abundance were likely low. Consequently, the estimated run of these fish was increased to the pre-season forecast of 800,000 fish. To control the escapement of Early Stuart fish, Area 29 was opened for gillnet fishing. Canadian gillnet fisheries in Areas 20 and 29, and Treaty Indian gillnet fisheries in Areas 4B, 5 and 6C were scheduled for the week of July 25-31, to begin harvesting summer-run sockeye.

On July 27, in response to a further increase to the Early Stuart run size to 875,000, Canada increased the gross escapement goal to 660,000 fish. Although a small TAC remained for Early Stuart sockeye, an opportunity also existed to achieve substantial early summer-run escapements. The Panel chose to maintain existing fishery closures and allow early summer-run fish to escape. Near the end of the July 25-31 week, the early-summer run appeared to be about ten days late and at least as abundant as forecast. Late Stuart sockeye predominated in marine area catches, while the dominant summer-run stock (Quesnel) was not yet evident along the coast and apparently very late. To harvest early summer-run and Late Stuart sockeye, fisheries during the week of August 1-7 were scheduled for Area 20 seines and gillnets, Area 29 gillnets, Treaty Indian gillnets in Areas 4B, 5 and 6C, and Treaty Indian and Non-Indian nets in Areas 6, 7 and 7A. Also during this period, concerns for a seabird (marbled murrelet) listed as a "threatened species" caused the United States to implement monitoring programs to assess seabird-net interactions in United States net fisheries.

During the week of August 1-7, the migration via Juan de Fuca Strait was low and the Johnstone Strait diversion rate was rising (60%). Consequently, to provide fish and fishing opportunities for the United States, the scheduled gillnet fishery in Area 20 was reduced by one day and additional time was given for Non-Indian reefnet fishing in Areas 6, 7 and 7A. Area 29 remained closed to allow additional escapements of early-summer stocks, although troll fisheries in Georgia Strait were opened for domestic allocation purposes. Additional openings were scheduled for the following week to allow United States fisheries on unshadowed fish: Treaty Indian gillnets in Areas 4B, 5 and 6C; Treaty Indian nets and Non-Indian seines and gillnets in Areas 6, 7 and 7A; and Non-Indian troll fishing in Areas 3 and 4. Area 20 nets and Area 29

gillnets were also scheduled during the week of August 8-14 to harvest summer-run sockeye. Other notable events this week included large seine catches of Quesnel and Late Stuart sockeye (480,000 fish) in Canadian Areas 1 and 2W, just west of the Queen Charlotte Islands. The peak of the Late Stuart run (Area 20 peak projected to be August 8-10) was expected to precede the Quesnel peak by 6-10 days, while the Quesnel run was expected to be two weeks late.

By August 10, larger than expected escapements of Late Stuart sockeye raised the possibility of too many Late Stuart and too few Quesnel escapements. Staff recommended an extension of the Area 29 gillnet fishery to prevent this, but Canada chose not to because such a fishery would conflict with a scheduled Fraser River Indian fishery. The United States responded with a concern that Canada's manipulation of harvest patterns for domestic purposes would result in changes to gross escapement goals that would affect the United States allocation. Meanwhile, a phenomenal record catch of 3,352,000 sockeye (previous record was 1,840,000 sockeye in one week ending August 19, 1989) were taken in a 2-day seine and 5-day gillnet fishery in Johnstone Strait (Areas 11-16). A continuing increase in the already high diversion rate (70-75%) meant that more fishing time was required in United States waters, so fisheries during the week of August 15-21 were scheduled for Treaty Indian and Non-Indian net fisheries. To harvest summer-run fish, Area 29 gillnets were also scheduled. The Area 18 troll fishery was closed from August 13 to August 16, when it would open until further notice. Meanwhile, staff reported that Quesnel sockeye were the dominant stock in all areas and that total summer-run returns would likely reach 13,500,000-15,000,000 fish.

The week of August 15-21 began with an additional day of fishing in the Area 29 gillnet fishery, a cancellation of the Non-Indian seine fishery on August 18, and additional fishing for Treaty Indian gillnets in Areas 4B, 5 and 6C and for Treaty Indian nets and Non-Indian reefnets in Areas 6, 7 and 7A. During this week, catches in a one-day seine and 5-day gillnet fishery in Johnstone Strait (2,773,000 fish) were almost as high as the record catches the previous week, for a total Johnstone Strait catch of about 6,125,000 sockeye in two weeks. These large catches when combined with low numbers escaping to the river gave inconsistent indications of what the total abundance of summer-run stocks would be. PSC staff reported a run-size estimate of 19,000,000 fish, but recommended the official run size remain unchanged until the availability of additional fish could be confirmed. Meanwhile, pink salmon were appearing on the west coast of Vancouver Island and in Johnstone Strait, but not in Juan de Fuca Strait. Canada now forecast the peak arrival date for Fraser pinks in Area 20 to be September 3 (about five days late), with a 29% diversion rate through Johnstone Strait. Area 20 remained closed to allow summer-run migration into United States waters and the river. Area 29 remained closed to allow summer-run escapement into the river. To continue harvesting Fraser sockeye in United States waters, the following fisheries during the week of August 22-28 were scheduled: Treaty Indian gillnets in Areas 4B, 5 and 6C and nets in Areas 6, 7 and 7A; and Non-Indian nets in 6, 7 and 7A.

Circumstances at the beginning of the August 22-28 week were not optimistic from a fisheries management point of view. Lower than expected sockeye escapements up to August 24 meant that summer-run escapements were significantly behind schedule and that the Johnstone Strait fishery the previous week had apparently been extremely efficient. Also, abundances in Juan de Fuca and Johnstone Straits were falling rapidly and the proportion of summer-run fish in troll catches on the west coast of Vancouver Island was dropping quickly. Consequently, run-size estimates based on the very large catches the previous week appeared to be too high. However, record seine catches in the Johnstone Strait test fishery later in the week indicated that an unexpected second peak was arriving and that 90% of these fish were arriving via Johnstone Strait. At the same time, estimates of pink salmon abundance were subject to conflicting indications: catch-to-date and scale characteristics suggested a small return, but a low average weight suggested a very high return. Pink salmon abundance was increasing in Johnstone Strait but few were appearing on the west coast of Vancouver Island. These data led to a run-size upgrade to 20,000,000 Fraser sockeye (largest since 1913) and a downgrade to 10,000,000 pinks. Canada subsequently increased the sockeye escapement goal to 5,366,000 fish and reduced the pink goal to 6,000,000 fish. These

changes generated uncaught allocations for groups in both countries. To harvest the remaining allocations, Non-Indian net fisheries in Areas 7 and 7A, and Treaty Indian net fisheries in Areas 4, 5 and 6C were opened. Fisheries were also scheduled for the week of August 29-September 4: Treaty Indian gillnets in Areas 4B, 5 and 6C and nets in 6, 7 and 7A; Non-Indian nets in Areas 7 and 7A; Canadian trollers in Areas 29 and 18 and gillnets in Area 29. To increase the probability of the United States achieving their allocation by maximizing the potential for "blowback" and possibly larger catches at Point Roberts, parts of Canadian gillnet Areas 29-4, -5 and -6 that lie close to the border were closed. Canada stated that it agreed to the restricted areas for this fishery only, and only because of the unusual current circumstances with the extremely high Johnstone Strait diversion.

Based on good escapements and catches in test and commercial fisheries, the run size of Fraser sockeye was increased to 21,000,000 fish on August 30 and then 22,000,000 the next day. A strong second peak of unfished summer-run sockeye (primarily Quesnel stocks) arrived in the river and resulted in a record single day catch in the Area 29 gillnet fishery, with 1,006 boats harvesting about 1,000,000 sockeye in the first 24 hours beginning August 30 and 1,370,000 in total for the 36 hour opening. To continue harvesting the available TAC, fisheries scheduled during the week of August 29-September 4 included Area 29 gillnets, Areas 29 and 18 troll, Treaty Indian nets in Areas 6,7 and 7A and Non-Indian gillnets in Areas 7 and 7A. Canada declined on a staff recommendation to extend the Area 29 gillnet fishery, to allow time for companies to process the very large catch and for fishers to repair gear and to rest. Later in the week, staff recommended all Area 29 sub-areas be opened for gillnet fishing to control summer-run escapement, because evidence that the United States catch was being affected by restricting the fishing areas near the border was lacking. However, the United States was firm in wanting the sub-area closures. Canada agreed to the restrictions under protest, stating that it viewed the sub-area closures as an undue disruption of a Canadian fishery and that it would raise the issue to the Commission. On September 3, the pink run still appeared to be much smaller than forecast, although the run size was increased to 12,000,000 fish. Fisheries were scheduled for the following week (September 5-11) to take international and domestic allocations, including Area 29 gillnets, Treaty Indian nets in Areas 6, 7 and 7A and Non-Indian gillnets in Areas 7 and 7A.

Larger than expected gross escapements of sockeye in the early part of the week of September 5-11, were due to a continued strong migration from Johnstone Strait, combined with the upstream movement of summer-run fish that had been delaying in the Strait of Georgia. Although Canada's pre-season plan called for Area 29 fisheries to cease by September 8, Canada agreed to open Area 29 on September 9 to harvest sockeye salmon to reduce an expected large inadvertent escapement of summer-runs and because there were few chinook salmon present. The ongoing fisheries in United States waters were expected to take the remaining allocation there. By the end of the week, a rapid decline in sockeye salmon abundance and achievement of pink salmon allocations suggested that no further net fishing would occur. Accounting of catches and escapements led to the estimate of sockeye run size being increased slightly to 22,400,000 fish. Inadvertent escapements of sockeye were anticipated to reach 400,000 fish (300,000 summer-run and 100,000 late-run). Meanwhile, the estimated pink salmon run size was reduced to 11,500,000 fish because of lower than expected catches in Johnstone Strait, while escapement to the Strait of Georgia appeared to be close to the goal of 6,000,000 fish. Test fishing in Area 20 ceased on September 13, however, the river test fishery was planned to continue for another month. The Panel relinquished control of Area 20 and United States Areas 4B, 5 and 6C, while the troll fishery in Areas 29 and 18 remained open to harvest additional late-run sockeye.

On September 11, a larger estimate of late-run abundance led to a small increase in the sockeye run size (22,500,000 fish). In response, Canada raised the late-run escapement goal to 600,000 fish (326,000 Birkenhead and 273,000 Weaver/Portage/Miscellaneous). To continue harvesting late-run fish, the troll fishery in Areas 29 and 18 was allowed to continue until September 18.

At the final in-season meeting of the Panel, the estimates of run size were 22,684,000 Fraser sockeye (857,000 Early Stuart, 396,000 early summer, 19,326,000 summer and 2,105,000 late-run) and 11,500,000 pink salmon.

Net fishing times in Canada's Area 20 (Table 5) were much less than anticipated in the pre-season plan. Seines and gillnets fished only 2 and 7 days, respectively, compared to the expected 15 and 26 days. The fishing season was also much shorter, lasting only two weeks for seines and three weeks for gillnets. These large differences were due mainly to the extremely high diversion of Fraser sockeye through Johnstone Strait, especially of summer-run stocks (75%), the much smaller than forecast pink salmon run, and to the need to allow enough fish into United States waters for international allocation goals to be achieved. In contrast, the amount of gillnet fishing time in Area 29 (11 days) was about 60% more than expected (7 days). The need to control summer-run escapement in the river was the main reason for additional gillnet fishing.

Table 5. Proposed versus actual fishing times (days) in major Canadian net fisheries in the Fraser River Panel Area in 1993.

Date	Area 20 *				Area 29 **	
	Purse Seine		Gillnet		Gillnet	
	Proposed	Actual	Proposed	Actual	Proposed	Actual
Jul.11-Jul.17	Closed	Closed	Closed	Closed	Closed	Closed
Jul.18-Jul.24	Closed	Closed	Closed	Closed	Closed	2
Jul.25-Jul.31	1	Closed	3	2	1	1
Aug.1-Aug.7	1	1	3	2	1	1
Aug.8-Aug.14	2	1	4	3	2	1
Aug.15-Aug.21	2	Closed	4	Closed	1	2
Aug.22-Aug.28	3	Closed	4	Closed	1	Closed
Aug.29-Sep.4	3	Closed	4	Closed	1	2
Sep.5-Sep.11	3	Relinq.	4	Relinq.	Closed	2
Sep.12-Sep.18	Closed		Closed		Closed	Closed
Sep.19-Sep.25	Relinq.		Relinq.		Closed	Closed
Sep.26-Oct.2					Closed	Closed
Oct.3-Oct.9					Closed	Closed
Oct.10-Oct.16					Relinq.	Closed
Total	15	2	26	7	7	11

* Area 20 fishing times are measured in 12- or 13-hour days to correspond with the duration of openings.

** Area 29 fishing times are measured in 24-hour days.

Net fishing times in United States Panel Areas (Table 6) were generally more than anticipated. Treaty Indian net fisheries in Areas 4B, 5 and 6C were open for 984 hours compared to an expected 672 hours, while fisheries in Areas 6, 7 and 7A were open for 433 hours compared to the 238 hours anticipated. For Non-Indian fisheries, seines fished slightly less and gillnets fished slightly more than pre-season projections. However, Non-Indian reefnets fished 240 hours instead of the expected 160 hours. The reason for generally longer than anticipated fishing times was the lack of sockeye in United States Panel Areas due to the very high diversion rate through Johnstone Strait. Opposing this trend was the reduction in the number of days for harvesting pink salmon because of the much lower than forecast abundance.

Table 6. Proposed versus actual fishing times (hours) in major United States net fisheries in the Fraser River Panel Area in 1993.

Date	Treaty Indian Areas				Non-Indian Areas 6, 7 and 7A					
	4B, 5 and 6C		6, 7 and 7A		Purse Seine		Gillnet		Reefnet	
	Proposed	Actual	Proposed	Actual	Proposed	Actual	Proposed	Actual	Proposed	Actual
Jul.11-Jul.17	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
Jul.18-Jul.24	96	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
Jul.25-Jul.31	96	132	28	Closed	29	Closed	28	Closed	32	Closed
Aug.1-Aug.7	96	168	27	28	32	16	28	12	32	48
Aug.8-Aug.14	96	168	28	88	29	16	28	19	32	Closed
Aug.15-Aug.21	96	168	27	113	32	16	28	33	32	80
Aug.22-Aug.28	96	168	28	84	29	48	28	40	32	80
Aug.29-Sep.4	96	168	100	93	Closed	16	Closed	42	Closed	32
Sep.5-Sep.11	Closed	12	Closed	27	Closed	13	Closed	34	Closed	Closed
Sep.12-Sep.18	Closed	Relinq.	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
Sep.19-Sep.25	Closed		Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
Sep.26-Oct.2	Relinq.		Closed	Relinq.	Closed	Relinq.	Relinq.	Relinq.	Relinq.	Relinq.
Oct.3-Oct.9			Relinq.		Relinq.					
Total	672	984	238	433	151	125	140	180	160	240

V. CATCH SUMMARY

A. Sockeye Salmon

The total return of 24,195,000 Fraser River sockeye salmon (Table 7) was 6,835,000 more than the pre-season forecast of 17,360,000 fish. This large run resulted in a catch of 17,768,000 sockeye. Both the run (Figure 2) and catch were the largest since 1913. Commercial, Indian and non-commercial components of the total catch were 16,621,000, 1,033,000 and 114,000 fish, respectively. The non-commercial catch included Commission test fishing catches totalling 87,000 sockeye.

The gross landed value of the commercial catch was approximately \$126,000,000 (Canadian) with a weight of 38,000,000 kg (84,000,000 lb).

Fraser sockeye were smaller than average in 1993. The average weight of sockeye caught in commercial purse seine fisheries in Area 20 was 2.30 kg (5.06 lb), compared to 2.63 kg (5.79 lb) for the last four cycle years (1977, 1981, 1985, 1989). Weights of age 4₂ fish sampled from commercial purse seine catches in Areas 12 and 20 averaged 2.20 kg (4.84 lb).

Table 7. Preliminary estimates of fishery catches and total run of Fraser River sockeye salmon during the 1993 fishing season, by country and area.

	<u>Number of Fish</u>	<u>% of Run</u>
COMMERCIAL CATCH		
CANADA		
Fraser River Panel Area		
Areas 121-124 Troll *	148,000	
Area 20 Net	460,000	
Areas 17-18 and 29 Troll	137,000	
Area 29 Net	<u>2,630,000</u>	
Total	3,375,000	13.9%
Non-Panel Areas		
Areas 1-10 Troll and Net	1,211,000	
Areas 11-16 Troll and Net	8,684,000	
Areas 124-127 Troll *	<u>477,000</u>	
Total	<u>10,372,000</u>	<u>42.9%</u>
CANADA TOTAL	13,747,000	56.8%
UNITED STATES		
Fraser River Panel Area		
Areas 4B, 5 and 6C Net	47,000	
Areas 6 and 7 Net	1,511,000	
Area 7A Net	<u>1,134,000</u>	
Total	2,692,000	11.1%
Non-Panel Areas		
Alaska Net	<u>182,000</u>	<u>0.8%</u>
UNITED STATES TOTAL	<u>2,874,000</u>	<u>11.9%</u>
COMMERCIAL TOTAL	16,621,000	68.7%
NON-COMMERCIAL CATCH		
CANADA		
Areas 12-13, 18, 20, 29, 123-124 Indian Fishery	185,000	
Area 12 Test Fishing	3,000	
Other Catches (Charters, etc.)	3,000	
Fraser River Indian Fishery **	848,000	
Recreational Fishery	<u>21,000</u>	
Total	1,060,000	4.4%
UNITED STATES		
Ceremonial and Test Fishing	0	0.0%
COMMISSION		
Areas 123-127, 20 and 29 Test Fishing	84,000	
Areas 7 and 7A Test Fishing	<u>3,000</u>	
Total	<u>87,000</u>	<u>0.4%</u>
NON-COMMERCIAL TOTAL	<u>1,147,000</u>	<u>4.7%</u>
TOTAL CATCH	17,768,000	73.4%
SPAWNING ESCAPEMENT		
TOTAL RUN	<u>6,427,000</u>	<u>26.6%</u>
TOTAL RUN	24,195,000	100.0%

* Troll catches in Area 124 are divided between Panel and non-Panel Areas.

** Mixed commercial and non-commercial catches in accordance with Canada's Aboriginal Fishing Strategy.

i. Canada

Canada caught a total of 14,807,000 Fraser River sockeye salmon (Table 7) in commercial and non-commercial fisheries. The commercial catch was 13,747,000 fish, 3,375,000 in Panel Areas and 10,372,000 in non-Panel Areas. Because of the very high diversion rate, the largest catches occurred in Johnstone Strait (Areas 11-16), in and near the Fraser River (Area 29) and in northern British Columbia (Areas 1-10). Purse seines took the largest share (49.3%) of the commercial catch, followed by gillnets (35.9%), outside trollers (11.8%) and inside trollers (3.0%) (Table 8). Weekly catches in Canadian fishing areas are shown in Appendix D (Tables 1-4).

Table 8. Preliminary estimates of Canadian catches* of Fraser River sockeye salmon by gear type and area during the 1993 fishing season.

Areas	Inside	Outside	Purse Seine	Gillnet	Total
	Troll	Troll			
1-10	0	560,000	646,000	5,000	1,211,000
11-16	274,000	440,000	5,879,000	2,091,000	8,684,000
121-127	0	625,000	0	0	625,000
20	0	0	248,000	212,000	460,000
17, 18, 29	137,000	0	0	2,630,000	2,767,000
Total Catch	411,000	1,625,000	6,773,000	4,938,000	13,747,000
% of Catch	3.0%	11.8%	49.3%	35.9%	100.0%

* Preliminary catch data from fish sales slips from DFO.

The Canadian non-commercial catch of 1,060,000 fish was split among the Fraser River Indian (848,000 fish), non-Fraser Indian (185,000 fish) (Table 7), recreational (21,000 fish), Area 12 test fishery (3,000 fish) and charter catches (3,000 fish). The Fraser River Indian catch, which in 1993 contained a commercial component (no estimate available), was the largest recorded for any year on record. Most of the catch (641,000 fish) was taken below Sawmill Creek and 207,000 were harvested upriver of this location (Appendix D: Table 5). Indian catches in marine areas (185,000 fish) also set a new record.

ii. United States

The United States caught 2,874,000 Fraser River sockeye salmon in 1993, 2,692,000 in commercial Panel Area fisheries and 182,000 in Alaska District 104 (Table 7). Most of the catch was taken in net fisheries in Areas 6, 7 and 7A. Treaty Indian catches were 47,000 fish in Areas 4B, 5 and 6C and 1,329,000 fish in Areas 6, 7 and 7A for a total of 1,376,000 Fraser sockeye (Table 9). Non-Indian catches were 726,000 fish in purse seines, 494,000 in gillnets and 96,000 in reefnets, for a total of 1,316,000 fish. Weekly catches of Fraser River sockeye salmon in United States Panel Areas are shown in Appendix D (Table 6).

Table 9. Preliminary estimates of United States catches* of Fraser River sockeye salmon by user group, gear type and area during the 1993 fishing season.

Areas	Test and				Total
	Ceremonial	Purse Seine	Gillnet	Reefnet	
Treaty Indian					
4B, 5 and 6C	0	0	47,000	0	47,000
6 and 7	0	455,000	262,000	0	717,000
7A	0	188,000	424,000	0	612,000
6, 7 and 7A Total	0	643,000	686,000	0	1,329,000
% of Catch	0.0%	48.4%	51.6%	0.0%	100.0%
Total Catch	0	643,000	733,000	0	1,376,000
% of Catch	0.0%	46.7%	53.3%	0.0%	100.0%
Non-Indian					
6 and 7		395,000	303,000	96,000	794,000
7A		331,000	191,000	0	522,000
Total Catch		726,000	494,000	96,000	1,316,000
% of Catch		55.2%	37.5%	7.3%	100.0%
United States					
Panel Area Total	0	1,369,000	1,227,000	96,000	2,692,000
Alaska (District 104) Catch					182,000
Total Catch					2,874,000

* Preliminary Washington catch data from Washington Department of Fisheries "soft system" totals.

B. Pink Salmon

The return of 17,009,000 Fraser River pink salmon (Table 10) was much smaller than the forecast 31,000,000 fish. This difference of 13,991,000 fish from the forecast was reflected in the total catch (6,234,000 fish), which was about 15,266,000 fish less than the pre-season projection (Table 1). The total catch consisted of commercial catches of 6,002,000 fish and non-commercial catches of 232,000 fish. Commission test fishing catches of 28,000 pinks are included in the non-commercial total.

The gross landed value of the commercial catch was approximately \$7,500,000 (Canadian) with a weight of 10,400,000 kg (22,800,000 lb).

The average size of pink salmon (1.73 kg, 3.8 lb) was the smallest on record (Figure 6). Pink salmon weights between 1987-93 (average 1.91 kg) were approximately 15% less than during the 1979-85 period (average 2.21 kg), when run sizes increased to present levels (i.e., 14-19 million fish on odd-year runs). Compared to average weights before 1979 (2.60 kg for 1959-77 period), Fraser pink weights for 1987-93 were about 25% lower.

Table 10. Preliminary estimates of fishery catches and total run of Fraser River pink salmon during the 1993 fishing season, by country and area.

	<u>Number of Fish</u>	<u>% of Run</u>
COMMERCIAL CATCH		
CANADA		
Fraser River Panel Area		
Areas 121-124 Troll *	111,000	
Area 20 Net	27,000	
Areas 17-18 and 29 Troll	135,000	
Area 29 Net	<u>131,000</u>	
Total	404,000	2.4%
Non-Panel Areas		
Areas 1-10 Troll and Net	376,000	
Areas 11-16 Troll and Net	3,197,000	
Areas 124-127 Troll *	<u>265,000</u>	
Total	<u>3,838,000</u>	<u>22.6%</u>
CANADA TOTAL	4,242,000	24.9%
UNITED STATES		
Fraser River Panel Area		
Areas 4B, 5 and 6C Net	9,000	
Areas 6 and 7 Net	885,000	
Area 7A Net	864,000	
Washington Troll	<u>2,000</u>	
Total	1,760,000	10.3%
Non-Panel Areas		
California / Oregon / Washington Troll	0	
Alaska Net	<u>0</u>	
Total	<u>0</u>	<u>0.0%</u>
UNITED STATES TOTAL	<u>1,760,000</u>	<u>10.3%</u>
COMMERCIAL TOTAL	6,002,000	35.3%
NON-COMMERCIAL CATCH		
CANADA		
Areas 12-13, 18, 20, 29, 123-124 Indian Fishery	0	
Area 12 Test Fishing	2,000	
Other Catches (Charters, etc.)	0	
Fraser River Indian Fishery **	17,000	
Recreational Fishery	<u>145,000</u>	
Total	164,000	1.0%
UNITED STATES		
Recreational Fishing	40,000	0.2%
COMMISSION		
Areas 123-127, 20 and 29 Test Fishing	28,000	
Areas 7 and 7A Test Fishing	<u>0</u>	
Total	<u>28,000</u>	<u>0.2%</u>
NON-COMMERCIAL TOTAL	<u>232,000</u>	<u>1.4%</u>
TOTAL CATCH	6,234,000	36.7%
SPAWNING ESCAPEMENT		
TOTAL RUN	<u>10,775,000</u>	<u>63.3%</u>
	17,009,000	100.0%

* Troll catches in Area 124 are divided between Panel and non-Panel Areas.

** Mixed commercial and non-commercial catches in accordance with Canada's Aboriginal Fishing Strategy.

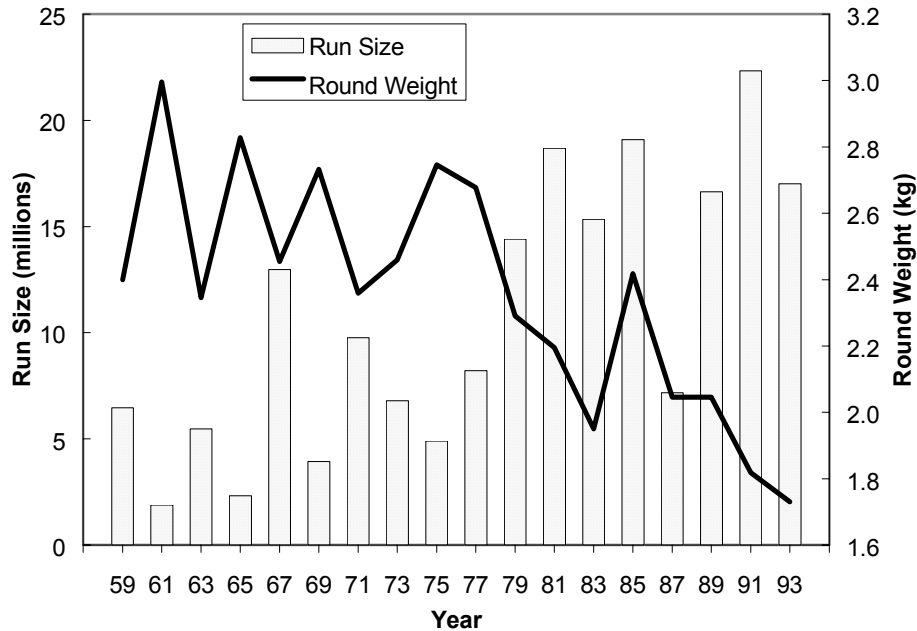


Figure 6. Run size and mean round weight (kg) of Fraser River pink salmon for odd years between 1959-1993.

i. Canada

Canada's catch of 4,406,000 Fraser River pink salmon (Table 10) consisted of a commercial catch of 4,242,000 fish and a non-commercial catch of 164,000 fish. The commercial catch was divided between 404,000 fish in Panel Areas and 3,838,000 in other areas. Most of the catch (3,197,000 fish) was concentrated in commercial net fisheries in Areas 11-16. The distribution of the commercial catch among the gear was 56.7% in purse seines, 28.5% by outside trollers, 8.2% in gillnets and 6.7% by inside trollers (Table 11).

Table 11. Preliminary estimates of Canadian commercial catches* of Fraser River pink salmon by gear type and area during the 1993 fishing season.

Areas	Inside	Outside	Purse Seine	Gillnet	Total
	Troll	Troll			
1-10	0	296,000	73,000	7,000	376,000
11-16	150,000	535,000	2,309,000	203,000	3,197,000
121-127	0	376,000	0	0	376,000
20	0	0	22,000	5,000	27,000
17, 18, 29	135,000	0	0	131,000	266,000
Total Catch	285,000	1,207,000	2,404,000	346,000	4,242,000
% of Catch	6.7%	28.5%	56.7%	8.2%	100.0%

* Preliminary catch data from fish sales slips from DFO.

The Canadian non-commercial catch consisted of a recreational catch of 145,000 fish, a Fraser River Indian catch of 17,000 and an Area 12 test fishing catch of 2,000 fish (Table 10).

ii. United States

The United States caught a total of 1,800,000 Fraser River pink salmon (Table 10), 1,760,000 in commercial and 40,000 in recreational fisheries. The large majority of commercially caught pinks were taken in net fisheries in Areas 6, 7 and 7A. Treaty Indians caught 883,000 fish, 9,000 in Areas 4B, 5 and 6C, and 874,000 in Areas 6, 7 and 7A (Table 12). Non-Indian commercial catches totalled 877,000 Fraser pinks, with 688,000 of these caught in purse seines, 134,000 in gillnets, 53,000 in reefnets and 2,000 by trollers. The non-commercial catch of about 40,000 fish was taken by sport fishers in Washington and Oregon coastal waters, Juan de Fuca Strait and Puget Sound.

Table 12. Preliminary estimates of United States commercial catches* of Fraser River pink salmon by user group, gear type and area during the 1993 fishing season.

Areas	Ocean Troll	Purse Seine	Gillnet	Reefnet	Total
Treaty Indian					
4B, 5 and 6C	0	0	9,000	0	9,000
6 and 7	0	456,000	59,000	0	515,000
7A	0	266,000	93,000	0	359,000
6, 7 and 7A Total	0	722,000	152,000	0	874,000
% of Catch	0.0%	82.6%	17.4%	0.0%	100.0%
Total Catch	0	722,000	161,000	0	883,000
% of Catch	0.0%	81.8%	18.2%	0.0%	100.0%
Non-Indian					
Calif./Oregon/Wash.	2,000	0	0	0	2,000
6 and 7	0	266,000	51,000	53,000	370,000
7A	0	422,000	83,000	0	505,000
Total Catch	2,000	688,000	134,000	53,000	877,000
% of Catch	0.2%	78.4%	15.3%	6.0%	100.0%
United States					
Panel Area Total	2,000	1,410,000	295,000	53,000	1,760,000
Alaska (District 104) Catch					0
Total Catch					1,760,000

* Preliminary Washington catch data from Washington Department of Fisheries "soft system" totals.

VI. STOCK MONITORING

The purpose of the stock monitoring program is to assess the run size, daily abundance, timing and migration pathways of Fraser River sockeye and pink salmon stocks at different points along their migration route during the fishing season. These data are required for developing fishing plans to attain annual escapement and catch allocation objectives. Commercial catches provide much of the data used in the analyses; however, the Commission conducts test fisheries to collect data before and after the commercial fishing season and between commercial fishing periods. Test fisheries conducted by DFO in Canadian non-Panel areas also provide important data. Information about the upstream migration in the river is obtained by echo sounding at Mission and visual observations at Hells Gate.

Test fishing operations in 1993 were conducted by the Commission in the following areas:

Canadian Panel Areas		
Areas 123-124	Troll	July 19 - August 20
Area 20	Purse Seine	August 4 - September 10
Area 20	Gillnet	June 20 - September 13
Area 29-13	Gillnet	June 28 - October 15
Area 29-16	Gillnet	June 23 - October 12
Areas 29-1 to 6	Troll	September 28 - October 1
Canadian Non-Panel Areas		
Areas 125-127	Troll	July 19 - August 28
United States Panel Areas		
Area 7	Gillnet	July 21 - 31

At the request of the Commission, DFO operated test fisheries in Area 12 between June 21-August 23 by gillnet and August 13-September 16 by purse seine.

Upstream passage of sockeye and pink salmon was monitored between June 25-October 17 using Mission hydroacoustic data combined with Cottonwood (Area 29-13) and Whonnock (Area 29-16) test fishing data. Between June 25-September 11, sockeye passage was estimated by multiplying hydroacoustic estimates of total salmon abundance by the proportion of sockeye salmon in test fishing catches at Whonnock. After September 11, Cottonwood CPUE models were used. Pink salmon passage for most days between June 25-September 11 was calculated the same as sockeye. However, escapement on six days (August 22, 24, 27, September 2, 4, 5) was estimated using Cottonwood CPUE models. After September 11, pink salmon passage was estimated by subtracting Cottonwood CPUE estimates of sockeye, chum, chinook and coho salmon abundance from the total hydroacoustic estimate. A wide-beam, 50 kHz echo sounder was used during the summer-run sockeye migration period. During the late-run sockeye and pink salmon migrations in September and October, a narrower beam 200 kHz sounder was used on most days.

Daily visual observations at Hells Gate between July 3-October 13 supplied information on upstream migration past this potentially difficult section of the river.

Run-size estimation for Fraser River sockeye salmon by stock group and for total pink salmon is based primarily on catch, effort, racial composition and diversion rate data, which are analyzed using catch-per-unit-effort (CPUE), cumulative-normal and cumulative-passage-to-date models. Catch-per-unit-effort models relate run sizes in previous years to commercial or test fishing catch and effort data from purse seine or gillnet fisheries in Canadian Area 20 and Johnstone Strait. These regression models assume that run size is directly related to the magnitude of the largest daily or weekly catch of a particular stock group in each year, and that the migration pattern is consistent from year to year. Consequently, CPUE estimates are assumed to be sensitive to unusual migration patterns through Juan de Fuca and Johnstone Straits such as bimodal runs, skewed runs, runs compressed into shorter than usual durations or distributed over longer than usual time periods, and runs with large seaward catch removals from the peak of the run. In-season, the current best estimates of catch, effort and racial composition are "plugged" into these models to generate run-size estimates, which tend to stabilize soon after the peak catch of a given stock group.

Cumulative-normal models are essentially a combination of "accounting" and linear regression methods. Estimates of catches and escapements of each stock group are accumulated for each day of migration. The number of these accounted fish are compared, using regression

models, to estimates from normally-distributed simulated migrations which differ in abundance and timing parameters. For each stock group, the simulated migration that most closely matches the observed abundance pattern represents estimates of both run size and timing. As with the CPUE models, the estimates are assumed to be sensitive to unusual migration patterns.

Cumulative-passage-to-date models utilize historical daily catch and escapement data by stock, which are adjusted to a Mission timing date. Numerical reconstructions of daily passage are then calculated. Average daily percent reconstructed passage is calculated for all available years, and referenced to a common mean peak date. Cumulative percent complete data are then calculated. During the season, daily catch and escapement data by stock are fed into the model. The run accounting to date (referenced to Mission) is used along with the best in-season assessment of timing to generate an estimate of total run by stock. Accurate assessments of timing are required for accurate run-size estimates to be produced.

A. Sockeye Salmon

The first Fraser River sockeye stock to arrive in coastal waters is the Early Stuart run. As in recent years, the migration of Early Stuart was later than average. The first in-season estimate on July 2, which is the average peak date in Area 20, indicated a very small run. On July 9, based on Juan de Fuca Strait (Area 20) test fishing data that indicated an Area 20 peak on July 2-4, run-size estimates ranged from 380,000 to 470,000 fish, or approximately half the forecast 800,000 fish. As an increasing portion of the run entered the Fraser River, run-size estimates also increased. The run peaked below the Pattullo Bridge (New Westminster) on July 15, approximately one week later than normal and one week later than indicated by Area 20 test fishing data. By the end of the migration, accumulated catch and escapement above Mission indicated a total run of 857,000 fish and a gross escapement of 628,000.

Later in July and early August, the focus was on early summer-run sockeye stocks. Initial assessments in late July indicated a smaller return than the forecast 433,000 fish. By August 12, the estimated return was 400,000-450,000 fish. By the end of the season the run was estimated at 383,000 fish, with a gross escapement past Mission of 157,000.

Pre-season expectations were for a high diversion (73%) of summer-run fish via Johnstone Strait. The first in-season confirmation of high diversion occurred on August 2-3, when 436,000 sockeye were caught in Canadian Area 2W. Also on August 2, comparisons of CPUE data from Area 20 and Area 12 gillnet test fishing indicated the diversion rate was 50-60%. The post-season estimate of Johnstone Strait diversion was 70%, based primarily on assessments of commercial catches in Johnstone Strait, Juan de Fuca Strait and Puget Sound.

Forecast summer-run returns totalled 15,350,000 fish, with an expected peak in Area 20 on August 18. Assessments on August 5 indicated a return of 13,000,000-13,500,000 fish, slightly less than forecast. Run-size updates are based primarily on Area 20 and Johnstone Strait catches, particularly when the fishery occurs on the peak of the run. Consequently, the Johnstone Strait closure during the week of August 22-28, which potentially could have been the peak of the summer runs, was a major concern. Purse seine test fishing catches in Areas 12 and 20 during August 18-24 indicated that the run was highly compressed in duration and not much larger than the pre-season forecast. Abrupt reductions in summer-run abundance, as indicated by declining CPUE's in Johnstone Strait seine and Pine Island troll test fisheries (lower part of Figure 7), and a shift in racial composition from summer- to late-run stocks in outside troll test fishing catches, were early signs that decisive management action would be required to achieve escapement and catch allocation goals.

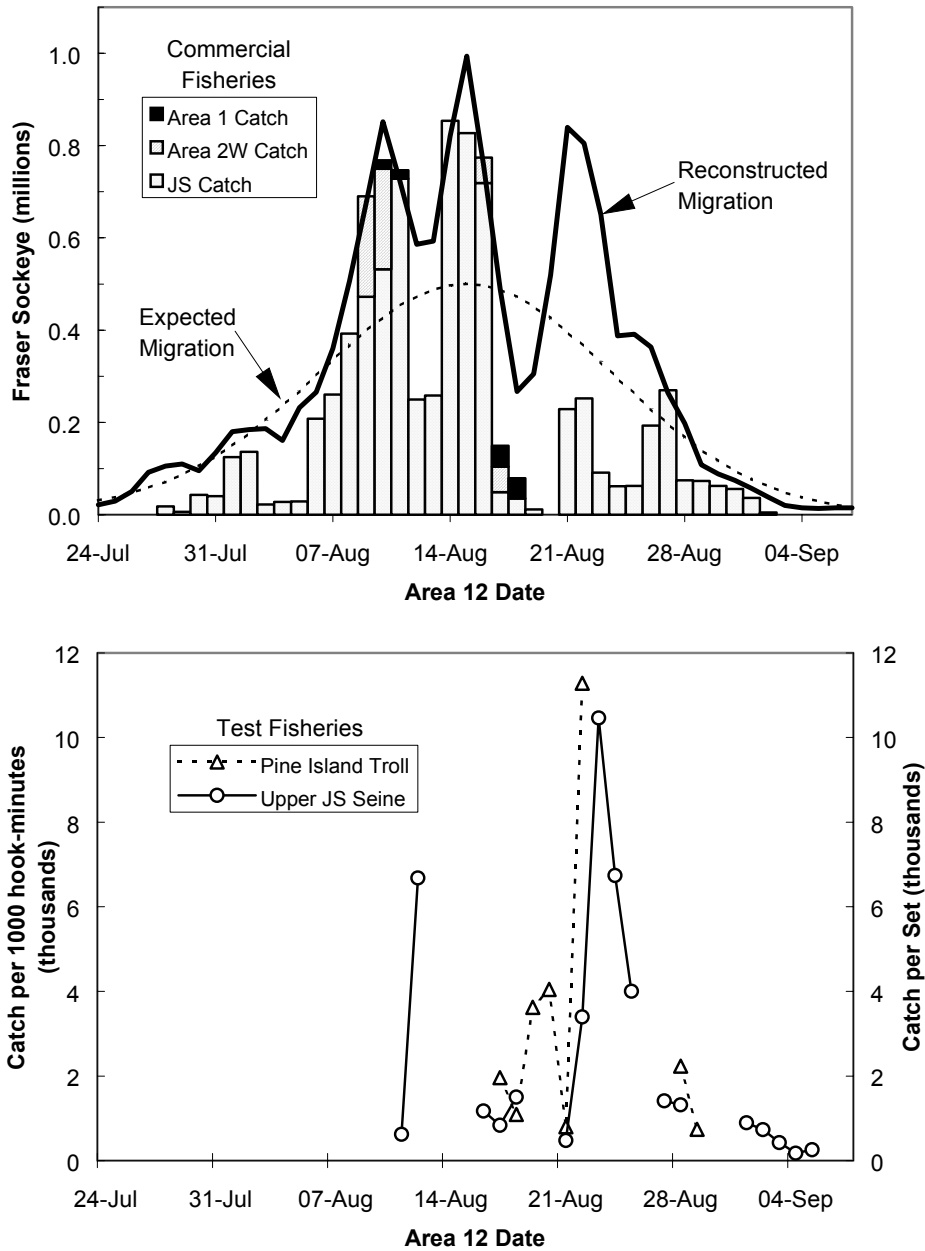


Figure 7. Reconstructed timing and abundance of Fraser River sockeye salmon in Johnstone Strait (Area 12) in 1993, compared to pre-season expectations, commercial fishery catches and test fishing CPUEs.

Record catches on August 24-27 (corresponding entering Area 12 dates are August 22-25 in Figure 7) in the Area 12 test fishery suggested that the run was strongly bimodal (see the reconstructed migration shown in the upper part of Figure 7). However, lack of solid corroborative information prevented the Panel from updating the run size until the abundance of the second peak could be ascertained in the Fraser River. Sockeye abundance in the Fraser River remained low until August 29, when a record test fishing catch at Cottonwood preceded a record commercial catch of 1,370,000 sockeye in the Area 29 gillnet fishery (36-hour duration) that began the next day. The estimated return of summer-run fish correspondingly increased to

17,000,000-19,000,000 fish on September 2. By the end of the season the estimated size of the summer run was 19,339,000 sockeye with a gross escapement past Mission of 4,354,000 fish.

Assessments of late-run sockeye abundance were confounded by the closures of the Johnstone Strait commercial fishery, and by estimates of late-run stock composition that were uncertain due to the very high relative abundance of summer-run sockeye. By September 2, the run size of late-run sockeye was estimated at 1,500,000 sockeye. End of season estimates of late-run production totalled 1,893,000 fish with a gross escapement of 366,000.

Daily escapements at Mission from June 23-September 9 are shown in Figure 8. The peak escapement occurred on August 28, when an estimated 428,000 sockeye passed Mission. The end of season Mission estimate of gross escapement totalled 5,505,000 adults, including Pitt River sockeye but excluding Fraser River Indian catches (196,000 fish) below Mission. Hydroacoustic tracking of salmon at Qualark Creek (located above Hells Gate and below Yale) by DFO scientists showed very high correlation with Mission hydroacoustic estimates.

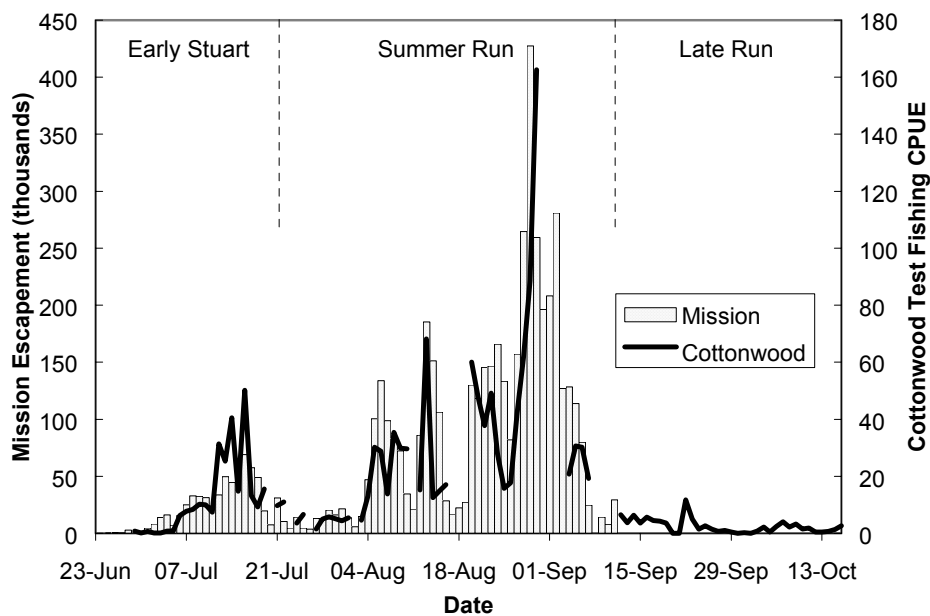


Figure 8. Daily escapements of sockeye salmon estimated at Mission by echo sounding compared with prior-day test fishing CPUE at Cottonwood during 1993.

Visual observations during the Early Stuart migration at Hells Gate indicated that a higher abundance of sockeye migrated upstream than were estimated hydroacoustically at Mission. However, Hells Gate counts during the summer-run migration were consistent with Mission hydroacoustic estimates. There were no apparent delays in the migration at any time during the sockeye migration. A strong migration of sockeye passed Hells Gate on August 31 to September 9, consistent with the large escapement of sockeye at Mission from August 27 to September 4.

B. Pink Salmon

Assessment of the timing and abundance of the Fraser River pink salmon migration in 1993 was difficult, because the peak of the Fraser pink run through Johnstone Strait (August 25) coincided with the closure of Johnstone Strait fisheries during the week of August 22-28. Run-size estimates were based on purse seine test and commercial fishery data, which were entered

into CPUE and cumulative-normal models. Proportions of Fraser River pink salmon in commercial and test fishery catches were initially estimated using pre-season forecasts of racial composition. However, approximately one week after each fishery, the estimates of proportions based on forecasts were replaced by estimates from genetic stock identification (GSI) analyses of muscle tissue samples taken after each fishery.

The pre-season run-size forecast for Fraser pinks was 31,000,000 fish. By September 3, the estimated run size totalled 12,000,000 fish. The estimate was revised to 11,500,000 on September 10, based on lower than anticipated catches in Johnstone Strait commercial fisheries and in test fisheries in Areas 12 and 20. No further updates occurred during the season. Approximately 64% of the run migrated through Johnstone Strait, much higher than the normal 30%.

The sum of estimates of pink salmon escapement past Mission based on hydroacoustic data was 3,849,000 (Figure 9). Historical experience has shown this estimate to be unrealistically low, so the estimate of escapement to the Strait of Georgia (6,050,000 fish) was used until DFO's spawning ground estimate was available after the season. Escapement into the Strait of Georgia was estimated by subtracting test and commercial catches from the run size estimate.

Pink salmon migrated upstream past Hells Gate without accumulation or delay.

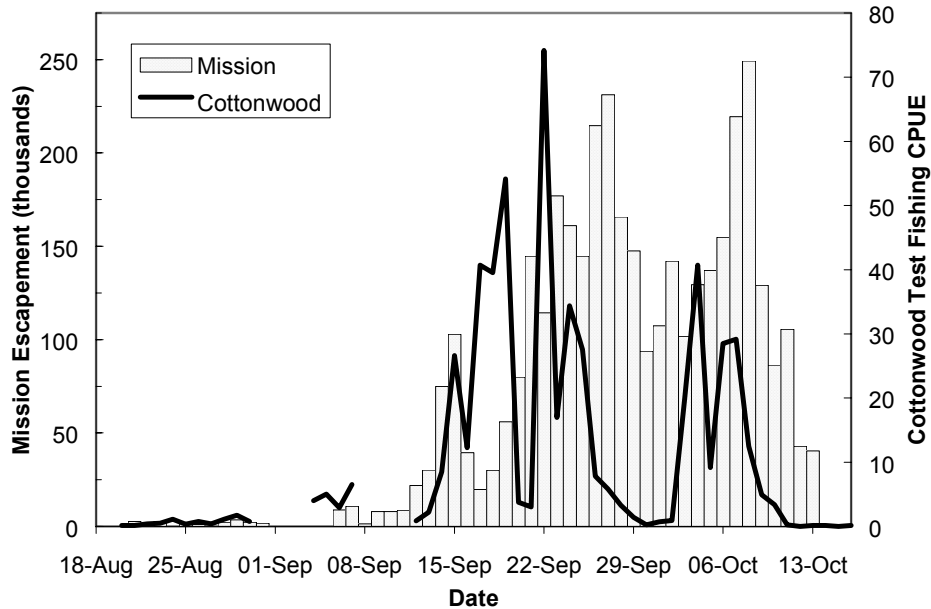


Figure 9. Daily escapements of pink salmon in 1993, estimated at Mission by echo sounding compared with test fishing CPUE at Cottonwood two days prior.

VII. RACIAL IDENTIFICATION

In 1993, Pacific Salmon Commission staff conducted programs designed to identify the stock proportions of Fraser River sockeye and pink salmon in commercial and test fishing catches. Such data provides information on the abundance and timing of these stocks as they migrate to the Fraser River. These data are also used to account for international and domestic catches of Fraser sockeye and pink salmon in coastal waters, and to apportion the daily Mission sockeye escapement estimates into discrete stock groups. The pink salmon stock identification program estimates the contribution rates of Fraser River pink salmon in mixed-stock fisheries, but does not

separate Fraser pink salmon into individual stock groups. Therefore, daily escapements of pink salmon past Mission are not available by individual stock group.

A. Sockeye Salmon

Identification of sockeye stocks in mixed-stock fishery samples is conducted using scale pattern analysis. Each year, PSC staff develop stock-specific baseline standards for the two dominant age-classes in Fraser River sockeye (age 4₂ and 5₂). In 1993, the age 4₂ baseline standards consisted of nine stock groups. Each stock group is formed by one or more individual stocks exhibiting similar scale traits and migratory timing.

Stock-specific baseline standards used for in-season racial analysis models come from two sources. First, age 4₂ standards are constructed using scales from prior year spawning ground returns of age 3₂'s (jacks), while age 5₂ standards are created using scales from age 4₂ returns. Second, when prior year data are unavailable, baseline standards are developed using data for the same age class in previous years. In recent years, low returns of age 3₂ Fraser sockeye has prevented their use in the development of age 4₂ baseline standards, except for a few stocks. Reliance on age 4₂ standards created from past years' age 4₂ scales can reduce the accuracy of in-season baseline standards compared to years when large numbers of prior year age 3₂ scales are available.

Linear discriminant function analysis (DFA) is used to distinguish among baseline standards and to combine individual sockeye stocks into stock groups. Subsequently, the contribution rates of each stock group in mixed-stock fishery samples are determined using linear DFA. Linear DFA is the technique of choice for the following reasons: it has proven to be useful in applications involving scale data; computer programs for linear DFA are readily available; and our scale data generally conform to the assumptions required for linear DFA. However, PSC staff will continue to assess the relative accuracy and precision of Maximum Likelihood Estimation (MLE) versus DFA analysis, which could result in future modifications to stock identification methodologies.

The differentiation of stock groups in samples of unknown mixture composition was achieved using four scale variables in 1993: circuli count to the first freshwater annulus, circuli count in the freshwater spring growth zone, distance from the focus to the fifth circulus, and distance from the focus to the first freshwater annulus. Supplementary data used in stock identification assessments include information on age composition, fish length and historical patterns of stock-specific timing and behavior. Data on fish length were particularly useful as an additional discriminating variable in northern British Columbia and south-east Alaska in-season analyses.

Scale analyses of commercial and test fishing catches were conducted daily, beginning in late June and continuing through mid October. Commission staff sampled commercial sockeye landings at sites in Bellingham and Blaine in Washington State, and Vancouver, Steveston, Port Renfrew, Port Hardy, Ucluelet, Winter Harbour and Prince Rupert in British Columbia. In addition, the Alaska Department of Fish and Game (ADF&G) obtained scale samples from the District 104 net fishery at landing sites in Petersburg and Ketchikan. In total, approximately 44,000 sockeye scales were aged and digitized in 1993.

The key stocks in 1993 included Early Stuart, Quesnel, Late Stuart, Chilko and Birkenhead. The most important priorities for the Racial Identification Group included the successful identification and separation of early summer-run stocks (a Nadina/Gates group and an early miscellaneous group composed of minor stocks) from summer-run stocks (dominated by Quesnel and Late Stuart stock groups); the separation of the key summer-run stocks from each other (Quesnel, Late Stuart and Chilko); and the separation of summer-run stocks from late-run stocks (Birkenhead and Weaver).

Analysis of baseline standards suggested that the models would perform well in 1993 in separating Early Stuart sockeye from early summer-run stocks; early summer-run from summer-run stocks (until the more abundant summer-run stocks dominated the early summer-run stocks); and summer-run from late-run stocks. In-season, it was difficult to separate the Chilko group from the Quesnel and Late Stuart groups using the jack scale standards. However, the key summer-run stocks (Quesnel and Late Stuart) were separated with a relatively high degree of accuracy.

In 1993, as in other recent years, a concerted effort was directed at obtaining scale samples from the Fraser River Indian fishery. At the request of the Commission, DFO attempted to arrange for weekly scale sampling at six fishing areas in the Fraser River watershed: Chilliwack, Yale, Lytton, Bridge River, Williams Lake and below Prince George. Unfortunately, with the exceptions of the Chilliwack and Yale fishing areas, DFO was able to obtain scale samples from only one or two weeks at the designated sampling locations. Subject to the constraints imposed by the small sample sizes, post-season analyses will compare the stock composition estimates derived from scale samples with those generated through reconstruction modelling techniques.

The Early Stuart stock arrived approximately one-week later than normal and the total return of 1,299,000 fish exceeded the pre-season forecast. Recorded catches of this stock include 182,000 fish in commercial areas and 230,000 fish in Fraser River Indian fisheries (Table 13). The exploitation rate for the recorded catch was 14%, excluding in-river Indian catches, and 32% for all catch areas.

Table 13. Catches, escapements and exploitation rates for Fraser River sockeye and pink salmon by stock group in 1993.

Stock Group	River & Ocean Catch *	Gross Escapement		Run Size		Portion of Run	Exploitation Rate	
		Fraser Indian Catch	Net Escapement	Adult	Jack		River & Ocean	All Areas
Sockeye Salmon								
Early Stuart	182,000	230,000	887,000	1,299,000	0	5%	14%	32%
Early Summer-run								
Fennell/Bowron/Raft/Pitt	152,000	42,000	36,000	230,000	0	1%	66%	84%
Nadina/Gates	56,000	16,000	50,000	122,000	1,000	1%	46%	59%
Total	208,000	58,000	86,000	352,000	1,000	1%	59%	75%
Summer-run								
Quesnel/Chilko	11,342,000	329,000	3,176,000	14,847,000	14,000	61%	76%	79%
Late Stuart/Stellako	3,712,000	226,000	1,895,000	5,833,000	2,000	24%	64%	67%
Total	15,054,000	555,000	5,071,000	20,680,000	16,000	86%	73%	75%
Late-run								
Birkenhead	808,000	5,000	246,000	1,059,000	12,000	4%	75%	76%
Weaver/Portage	621,000	0	105,000	726,000	7,000	3%	85%	85%
Miscellaneous	15,000	0	6,000	21,000	22,000	0%	35%	35%
Total	1,444,000	5,000	357,000	1,806,000	41,000	8%	78%	78%
Total Adults	16,888,000	848,000	6,401,000	24,137,000	58,000	100%	70%	73%
Total Jacks	32,000	0	26,000	58,000				
Total	16,920,000	848,000	6,427,000	24,195,000				
Portion of Total Run	69.9%	3.5%	26.6%	100.0%				
Pink Salmon								
Total	6,217,000	17,000	10,775,000	17,009,000	0	100%	37%	37%
Portion of Total Run	36.6%	0.1%	63.3%	100.0%				

* Includes ocean and river catches in commercial, test and other fisheries, excluding the Fraser River Indian fishery.

Early summer-run stocks arrived slightly later than normal and smaller than the pre-season forecast of abundance. These early-timed stocks had a total return of 353,000 fish, including adult catches in commercial areas of 208,000 fish (a 59% exploitation rate) and in Fraser River Indian fisheries of 58,000 fish, representing a total exploitation rate of 75%.

Quesnel and Late Stuart stock groups dominated the summer run. Quesnel stocks were almost three weeks late and significantly more abundant than forecast. In total, 14,861,000 sockeye from the Quesnel/Chilko group returned to coastal areas. Adult catches in commercial fishing areas totalled 11,342,000 fish, while catches in Fraser River Indian fisheries amounted to 329,000 fish. The Late Stuart/Stellako group also returned in large numbers (5,835,000 fish), exceeding the pre-season forecast. This group was approximately two weeks late. Adult catches in commercial areas and Fraser River Indian fisheries totalled 3,712,000 and 226,000 fish, respectively. Total production from all summer-run stocks was 20,696,000 fish. Catches in commercial areas totalled 15,054,000 adults, and the preliminary estimate of Fraser River Indian catches was 555,000 fish. The exploitation rate for summer-run stocks was 73%, excluding in-river Indian catches, and 75% for all catch areas.

The arrival timing of late-run stocks was near normal. Approximately 1,071,000 fish from the Birkenhead group, 733,000 fish from the Weaver group and 43,000 miscellaneous fish returned, for a total of 1,847,000 late-run fish, much larger than the forecast abundance. Estimated adult catches of late-run sockeye were 1,444,000 fish in commercial areas and 5,000 in Fraser River Indian fisheries. The exploitation rate for late-run stocks was 78%, excluding Fraser River Indian catches, and 78% in all areas.

The total 1993 return of Fraser River sockeye was estimated to be 24,195,000 fish, the largest run since 1913. Catches in all fisheries accounted for 73% of the adult fish while 27% reached the spawning grounds. Commercial and test fisheries harvested 70% of the 1993 return while Fraser River Indian catches accounted for 3.5%. Of the total Fraser run, 94.3% were age 4₂, 4.4% were age 5₂, 1.1% were age 5₃ and 0.2% were age 3₂.

i. *Philonema* Studies

To assess the utility of additional variables for stock identification of Fraser River sockeye salmon, PSC staff continued two pilot programs in 1993: a screening project for the parasite *Philonema oncorhynchi* and a sockeye morphometric measurement project.

Philonema oncorhynchi is a nematode parasite found near the swim bladder in adult sockeye salmon. The parasite is eliminated during evisceration and is not believed to cause significant harm to the fish, nor does it affect the marketability of the fish. Previous studies have established that Fraser River sockeye salmon show a low prevalence of *Philonema* compared to most north coast sockeye stocks (e.g., Skeena, Nass and south-east Alaskan stocks). In 1993, at sampling sites in Prince Rupert and Vancouver, PSC staff screened purse seine and gillnet catches from Canadian Areas 1, 2W, 3, 4, 12, 20 and 29 for prevalence of *Philonema*. Staff from ADF&G, with funding provided by the PSC, performed a similar screening for *Philonema* in catches in Alaskan Districts 101, 104 and 106.

From selected streams in Fraser River and Alaskan watersheds, additional sampling was conducted to obtain data on *Philonema* prevalence. The goal is to develop a comprehensive baseline of *Philonema* prevalence across many stocks and years.

As in the 1992 study, the program included laboratory verification of *Philonema* prevalence data collected from field sampling sites in British Columbia and Alaska. Detailed laboratory

examinations are conducted to determine the amount of bias in the field collected data. If biases occur, then field data will require correction before it is used for stock identification assessments.

Eventually, the PSC hopes to use *Philonema* prevalence to help distinguish between Fraser River and north coast sockeye salmon in fisheries where mingling occurs. This will include the use of *Philonema* prevalence data as a discriminating variable, along with scale characters, in future discriminant function analyses.

ii. Morphometric Studies

Morphometric variation refers to differences in body shape among stocks. Several studies have shown that morphometric measurements can be a useful stock identification tool. Initial spawning ground assessments conducted by the PSC's Racial Identification Group in past years showed that morphometric variation exists for Fraser River sockeye salmon, especially in the posterior body region.

Morphometric screening in 1993 was conducted at several sockeye spawning streams: Horsefly River, Tachie River (Late Stuart system), Chilko River, Stellako River, Birkenhead River and Weaver Creek. In addition, morphometric data were collected from Early Stuart sockeye salmon caught in early July in an Area 29 test fishery. Investigations into the utility of incorporating morphometric variation among stocks as a distinguishing variable in discriminant function models will continue in future years.

B. Pink Salmon

Catches of Fraser River pink salmon harvested in mixed-stock fisheries from northern British Columbia to Washington are identified by genetic stock identification (GSI). Information on the timing and abundance of Fraser River pink salmon in coastal waters is obtained from the results of GSI analyses of commercial catch samples.

The GSI technique requires knowledge of the genetic differences among stocks that potentially contribute to the fisheries of interest. Electrophoretic analysis of tissue samples from pink salmon collected on the spawning grounds yields a "baseline" of genetic standards. The PSC uses separate north coast and south coast baselines, each designed to represent the stocks that contribute to fishery catches that occur to the north or south of Cape Caution. The genetic composition of tissue samples from pink salmon caught in fisheries are compared to the appropriate baseline of genetic standards to estimate the stock composition of specific mixed-stock fisheries. "Maximum likelihood" computer models allow estimation of the contribution by stock for each fishery of interest.

As in past years, the PSC conducted GSI analyses of samples from commercial and test fishing catches from mid July through mid September. However, due to low pink salmon abundance in southern waters during the early stages of the run and to the small TAC generated by the small in-season run-size estimate, fewer fisheries were directed at Fraser pink salmon than in recent years. Consequently, the 1993 in-season GSI field sampling program was less active than in past years. During the in-season fishing period, commercial pink salmon landings were sampled at: Bellingham, Blaine, Vancouver, Steveston, Ucluelet, Tofino, Winter Harbour and Prince Rupert by PSC staff; and Port Hardy, Alert Bay and Quathiaski Cove by DFO staff. In total, GSI analyses were conducted on approximately 8,220 pink salmon in 65 collections to determine the proportion of Fraser River pink salmon in fishery mixtures. Stock contribution estimates for both Fraser and non-Fraser stock groups were multiplied by catch in each fishery to generate summaries of catch by stock group by area and gear type.

The results of in-season GSI analyses were incorporated in periodic staff assessments of Fraser River pink salmon run strength. The results of these analyses assisted the Fraser River Panel in making adjustments to the pre-season fishing plan. In turn, the revised fishing pattern helped to achieve international and domestic catch allocation objectives and the gross escapement goal. The end of season estimate of Fraser River pink salmon run size was 11,536,000 fish, significantly below the pre-season forecast of 31,000,000 fish. However, DFO's estimates of spawning escapement have increased the estimated total return to 17,009,000 fish.

Catches of Fraser River pink salmon in northern fisheries (north of Cape Caution) were small in 1993 (376,000 fish), but were consistent with GSI findings in recent past years. Catches of Fraser pinks were very low in July (<5% of each sample analyzed). During the first week of August, the percentage increased to approximately 10% of the catch in Canadian troll fisheries in Areas 101 and 142 and net fisheries in Areas 1 and 2W. A further jump, to over 80% of the catch, occurred in fisheries in Areas 2W and 142 the following week. Catches peaked during the week of August 8-14 when approximately 187,000 Fraser River pink salmon were caught in northern British Columbia waters. This total was 46% of the Fraser pink catch landed in northern area waters for the entire season. After mid-August, catches of Fraser pinks in these fisheries declined rapidly as the fish continued their southerly migration.

The total catch of Fraser River pink salmon in commercial fisheries conducted south of Cape Caution in 1993 was 5,626,000. Of this total, Canada harvested approximately 4,242,000 fish and the United States harvested 1,760,000 fish. Commercial fisheries landed low numbers of Fraser pinks from July through early August. During the week of August 8-14, catches of Fraser pink salmon increased in the west coast of Vancouver Island troll fishery (96,000) and Johnstone Strait net fishery (200,000). Fraser pink catches dominated in all south coast fisheries after the middle of August. Peak catches occurred in Canadian waters, primarily in Areas 11-16, during the week of August 29-September 4 (1,267,000, 81% of the total pink catch for the week). Peak catches in United States waters occurred during the same week (712,000, 95% of the total pink catch for the week).

The return of Fraser River pink salmon was estimated to total 17,009,000 fish, including a river and ocean catch of 6,217,000 fish, a Fraser Indian catch of 17,000 and DFO's spawning escapement estimate of 10,775,000 fish (Table 13). The calculated exploitation rate from these numbers is 37%.

VIII. ESCAPEMENT

Canada Department of Fisheries and Oceans estimates the annual escapements to sockeye and pink salmon spawning grounds in the Fraser River watershed (Figure 10). These data along with biological samples from the spawners are provided to the Commission so that PSC staff can revise in-season racial analyses, estimate total production for each stock and assess Commission programs for stock monitoring.

A. Sockeye Salmon

Preliminary estimates of sockeye salmon escapements to spawning grounds in the Fraser River watershed totalled 6,427,000 fish, including 6,402,000 adults (4- and 5-year-old fish) and 26,000 jacks (3-year-old fish) (Appendix D: Table 7). This was the largest spawning escapement since 1909, and resulted in record escapements for many individual stocks. Adult spawning escapements were 24% above the final in-season goal of 5,100,000 fish. The largest deviations from spawning escapement goals occurred in the Stuart Lake area: both Early Stuart and Late Stuart spawner abundances substantially exceeded their respective goals.

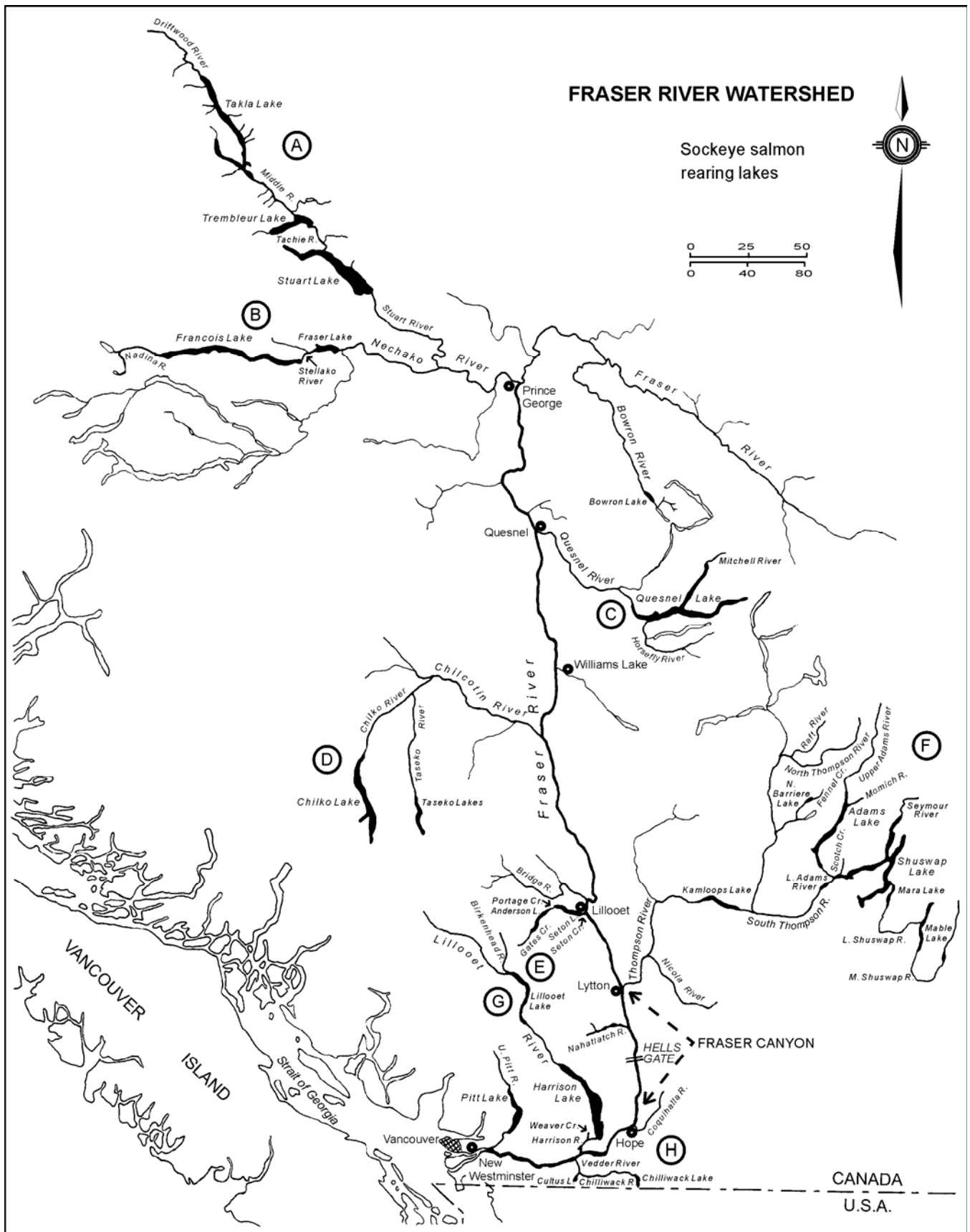


Figure 10. Sockeye salmon spawning grounds in the Fraser River watershed.

The pre-season goal for escapement to Early Stuart spawning streams (tributaries to Takla and Trembleur Lakes, A; Figure 10) was 300,000 adults. DFO's preliminary escapement estimate was 887,000 fish, nearly three times the goal. This was the largest escapement on record and was 130% above the brood year spawning population (385,000 fish) in 1989. Spawning areas in all tributary streams were well filled. Driftwood River spawners totalled 448,000 fish, half the total Early Stuart escapement. Although this was a 79% increase over Driftwood River escapements in 1989, it represented the lowest percentage increase observed of the four Early Stuart sub-stock groups (Trembleur Lake tributaries, Middle River, Takla Lake and Driftwood River). The largest increases occurred in Takla Lake tributaries, which increased four-fold from 55,000 spawners in 1989 to 215,000 in 1993. Meanwhile, spawning populations in Trembleur Lake tributaries tripled from 32,000 to 102,000 fish, and in Middle River tributaries increased from 48,000 to 122,000 spawners. Spawning success, as measured by low numbers of retained eggs in female carcasses, was good in all spawning areas.

Late Stuart sockeye salmon spawn in Middle and Tachie Rivers and in several small tributaries to these rivers and to Stuart Lake. The main spawning areas are the two trunk streams between the large lakes in the system. Because the lakes remain warm into the fall, stream temperatures do not decline as rapidly as in tributaries occupied by Early Stuart spawners. Therefore, Late Stuart sockeye spawning peaks at the end of September compared to early August for the early run. The preliminary estimate of spawners in Late Stuart areas was 1,805,000 fish, a three-fold increase from 1989 and by far the largest escapement recorded in the system. Most of the population (1,392,000 fish) spawned in Tachie River and its tributaries, a five-fold increase over 1989 returns (291,000 fish). Juveniles from this population rear in Stuart Lake, the most productive lake in the area. Because juveniles from the other large stocks in the Stuart Lake area rear in other lakes (i.e., Early Stuart juveniles rear in Takla and Trembleur Lakes and Middle River (Late Stuart) juveniles rear in Trembleur Lake), the large abundance of Tachie River juveniles will not depress the growth of these populations. Escapements to Middle River and its tributaries totalled 398,000 sockeye, 44% more than the 1989 escapement.

Stocks in the Nechako watershed (B; Figure 10) are not abundant on the 1993 cycle, so spawning populations were at moderate levels. Nadina River sockeye escapements totalled 9,600 fish, which is 94% above brood year abundances in 1989 but substantially lower than in some past cycle years (e.g., 19,000 fish in 1981). Of the total, 8,600 entered the spawning channel. The abundance of Stellako River spawners, the second major stock in the watershed, doubled from 43,000 fish in 1989 to 91,000 fish in 1993. The Nechako watershed total (101,000 fish) was the largest spawning population recorded on the cycle, which is one of two off cycles (1992 and 1993 cycles) exhibited by these stocks. The majority of Stellako River spawners (65%) were 5-year-old fish from the large 1988 brood.

The spawning escapement of Quesnel Lake area sockeye (C; Figure 10) reached a new record of 2,620,000 adults, which was 40% higher than the brood year escapement (1,871,000 fish) but slightly below the pre-season goal (2,650,000 fish). Escapement to Horsefly River spawning areas was only 252,000 fish (16%) more than the very successful 1989 spawning. Mitchell River escapement, however, tripled to 725,000 spawners from the brood year level of 241,000 fish. Heavy commercial fishing on the early portion of the Quesnel run (mainly Horsefly River sockeye) was relaxed in late August, resulting in large escapements of Mitchell River and other later-timed stocks. The large escapement that was observed passing Mission in the last week of August was probably largely composed of these later-timed stocks. Excellent spawning success for upper and lower Horsefly River and Mitchell River populations was observed by DFO field crews.

A very substantial increase in the escapement of Chilko stocks (D; Figure 10) occurred in 1993, perhaps related to DFO's lake enrichment program which commenced at Chilko Lake in the summer of 1990. The 1993 cycle has been the off-cycle since the 1995 cycle year Chilko population crashed in 1961. The 1989 escapement of 63,000 spawners to river and lake spawning

areas was slightly above average for the cycle. However, the 1993 spawning population soared to a cycle record of 555,000 adults, a nine-fold increase over 1989 returns, so production for the 1993 off-cycle may now be commensurate with the other cycles in future years, if production levels are maintained. Most spawners (88%) were 4-year-olds from the 1989 spawning. Of the total escapement, 5,400 fish entered the spawning channel. The distribution of spawners between river and lake spawning areas was not monitored.

Compared to recent cycle years, escapements to spawning areas in the Seton-Anderson system (E; Figure 10) increased in 1993. Gates Creek spawners totalled 18,000 fish in the river and spawning channel, compared to 17,000 fish in 1989. Most of these (16,800) used the spawning channel. Escapements of Portage Creek sockeye, a late-run stock that is the second largest in the Seton-Anderson system, jumped to a cycle record of 19,800 spawners from 7,900 in 1989. This is notable because previous escapements on the 1993 cycle have been mediocre, at best, and this abundance is at or above the 1990 dominant-cycle escapements in recent years. Both Gates Creek and Portage Creek stocks have shown steady growth in production and escapement in recent years.

The 1993 cycle is the off-cycle for most Thompson River sockeye stocks (F; Figure 10). Escapements to North Thompson River tributaries increased to 13,000 fish from 5,600 in 1989. Fennell Creek has had low populations on the cycle for many years, but in 1993 a cycle-year record 7,500 spawners arrived. Raft River escapements totalled 5,000 spawners, a tripling of the 1989 returns. South Thompson River summer-run stocks showed good growth in 1993, increasing to 19,300 spawners from 13,000 in 1989. The majority of these fish (10,100) spawned in Seymour River. Scotch Creek escapements reached 8,400 fish, an increase of 16% from the brood year. Late-run escapements on the 1993 cycle are mainly 3-year-old fish (jacks) returning prior to the dominant 4-year-old fish in 1994. Spawners in the Adams River area totalled 8,100 fish, but only 500 adults. A population of 2,700 spawners arrived at Lower Shuswap River areas, but again only 700 were adults.

Large escapements were observed in the Harrison-Lillooet system in 1993. Birkenhead River sockeye escapement increased from 29,000 in 1989 to 245,000 adult spawners. This nine-fold increase was mostly due to a strong return of 5-year-old sockeye from the 1988 spawning. The Weaver Creek escapement showed a strong recovery in 1993 (85,000 fish in the spawning channel and Creek) after having experienced a major decline (17,100 fish) in 1989. Harrison River sockeye showed an escapement of 3,300 fish, similar to 1989 (2,900).

Lower Fraser River tributaries showed mixed results in spawning populations. Nahatlatch River and Lake stocks were estimated at 2,100 spawners, a decrease from 3,600 in 1989. Upper Pitt River escapements (mostly 5-year-old adults) totalled 23,000 fish, a 42% increase over the 1989 spawning. Cultus Lake escapements have been depressed for many years on the cycle and, in 1993, only 1,100 fish spawned. However, this total was over double the brood year escapement. Reduced fishing in migratory areas in the latter part of August undoubtedly led to larger escapements of late-run stocks in 1993.

The estimated spawning success for the whole Fraser River watershed was 98.4%, yielding an effective female (females that successfully deposited eggs) population of 3,791,000, an increase of 136% compared to 1989. In many sockeye spawning areas in the watershed, low water levels occurred during spawning and throughout the winter during incubation of the eggs and alevins.

B. Pink Salmon

The abundance of pink salmon upstream of Hells Gate could not be confirmed in 1993 because of the discontinuation of spawning ground enumerations on all tributaries, including those above Hells Gate, such as Bridge River, Seton Creek and Thompson River. From 1987 to

1991, to estimate pink salmon escapements, DFO conducted a program similar to one developed and employed by the International Pacific Salmon Fisheries Commission (IPSF) from 1957 to 1985. In the program, fish from all Fraser River stocks were tagged as they migrated upriver past Duncan Bar or Glen Valley Bar, located upstream of Fort Langley. Populations of spawners in the four major tributaries, Seton Creek, Thompson River, Chilliwack-Vedder River and Harrison River, were estimated by tagging and recovery programs in each tributary. Smaller populations on other tributaries were visually estimated. The proportion of Duncan Bar-tagged fish that were recovered in the tributaries were used to estimate the total number of Duncan Bar-tagged fish that spawned in these streams. These estimates were subtracted from the total number of Duncan Bar-tagged fish released, and the remaining number of tagged fish were assumed to have spawned in the mainstem Fraser River between Hope and Chilliwack. Recovery of carcasses in the mainstem provided a untagged:tagged ratio which, when applied to the estimated number of tagged fish in the mainstem, provided an estimate of the mainstem population.

The historical approach which generated estimates for all individual spawning areas had to be abandoned because there were insufficient funds available to Department of Fisheries and Oceans to implement defensible mark-recapture enumeration programs for all major spawning areas. Accordingly, tagging programs were limited to a single tag release site to estimate a system-wide escapement in 1993. Specific modifications to the design in 1993 included: (i) measures to reduce tagging/handling effects while tagging; (ii) an assessment of the effects of holding times in beach seine nets while tagging on recovery rates; (iii) increased recovery sampling effort and the implementation of systematic sampling to provide better temporal and spatial coverage during the carcass recovery program including a re-sampling program to estimate the number of “missed” tags; (iv) an experimental ‘live’ recovery sampling program to assess the consistency of population estimates between it and the standard carcass recovery program; (v) a double tagging experiment to measure tag loss and assess the utility of different tag types; and, (vi) the use of a stratified Petersen population estimator to assess the severity of assumption violations in pooled Peterson estimators. The program was limited to tagging at Duncan Bar and, to estimate the untagged:tagged ratio, recovering fish at two sites: Strawberry Island where migrating fish were caught by beach seining and on the mainstem Fraser spawning grounds where carcasses were examined in a dead recovery program. Data from the two sites provided similar estimates of spawning escapement from 10,800,000 to 11,100,000 fish. The final estimate provided by DFO and used for calculations of total run size, TAC and catch allocations, was 10,775,000 spawners (Appendix D: Table 8).

One issue which could not be addressed in 1993 was whether immediate mortality could be large enough to cause a serious bias (inflating the estimated value). The Salmon Subcommittee of DFO’s Pacific Stock Assessment Review Committee (PSARC) reviewed the estimation procedures. The Subcommittee noted that future tagging programs should be designed to evaluate short-term (immediate) tagging mortality and evaluate the vulnerability of tagged pinks to different sampling gears. Because tags are applied to migrating stocks during a fixed eight hour period there was a concern that recaptures of tags further upstream during a similar eight hour period would produce a biased estimate of the tag recapture rate. The Subcommittee concluded, therefore, that the ‘live’ recapture programs be structured to test for non-random mix of tagged and untagged. The Subcommittee was concerned that the vulnerability of fish tagged with Petersen disks to in-river gillnet fisheries would result in the disproportionate removal of tagged fish. In the event of more intensive in-river net fisheries an alternate tag should be considered to assess the effects of gillnet fisheries on recapture rates.

Because the 1993 program did not estimate individual populations in the major spawning areas of the Fraser watershed, there is a critical gap in the long (since 1957) dataset of specific spawning area abundances. This gap will grow larger with each passing year at a time when escapement abundances may well exceed current records on a regular basis. Data that extend the previously observed ranges in escapements are crucial for any analysis involving recruitment data, and are especially important when significant long-term changes in environmental conditions may

be influencing survival rates. For example, both the estimated total recruitment (22,333,000 fish) and marine survival rate (6.2%, Appendix D: Table 9) for the 1989 brood were the highest on record. In addition, the 1991 spawning population then produced the largest fry abundance on record. Thus, the loss of tributary escapement data will be to seriously compromise the future ability of scientists and management biologists to understand specific stock dynamics and to relate them to environmental conditions. Vital data on stock performances related to habitat perturbations would be lacking in the future, as well.

IX. ACHIEVEMENT OF OBJECTIVES

The mandate of the Fraser River Panel is to manage fisheries in the Panel Area to achieve the annual goals for gross escapement of Fraser River sockeye and pink salmon, for international allocation of the TAC, for domestic allocation of the catch within each country's share, and to consider conservation concerns for other stocks and species of salmon when planning and conducting the fisheries. Panel management strategies are assessed after each season to determine whether the goals were met, to estimate catch deficiencies that require future attention and to improve management techniques and data collection programs.

A. Escapement

The primary objective of the Fraser River Panel is to ensure that gross escapement goals are achieved. On July 9, 1993, Canada set an initial gross escapement goal of 4,837,000 sockeye salmon, including 4,710,000 adults and 127,000 jacks (Table 1). This gross escapement provided for an anticipated catch of 965,000 fish in the Fraser River Indian fishery and an adult spawning escapement of 3,745,000 adults. Canada also provided the Panel with a schedule to modify Early Stuart gross escapement goals as in-season estimates of run size and TAC developed. Canada modified the escapement goals during the season as the magnitudes of the runs became apparent. Final in-season gross escapement goals are shown in Table 14.

Table 14. Comparison of final in-season goals, Mission estimates and upriver estimates (Fraser River Indian catches + spawning escapements) of gross escapements of Fraser River sockeye and pink salmon runs in 1993.

Run	Gross Escapement		
	In-season Goals	Mission Estimates *	Upriver Estimates *
Sockeye Salmon			
Early Stuart	660,000	662,000	1,117,000
Early Summer	204,000	166,000	144,000
Summer	4,090,000	4,502,000	5,626,000
Late	600,000	387,000	362,000
Adults	5,554,000	5,717,000	7,249,000
Jacks	127,000		26,000
Total	5,681,000		7,275,000
Pink Salmon			
Pink Salmon	6,105,000	3,849,000	10,792,000

* Includes 196,000 sockeye salmon caught in Fraser River Indian fisheries below Mission, B.C.

In 1993, Mission (hydroacoustic) and upriver (Fraser River Indian catches plus spawning escapements) estimates of gross escapements totalled 5,717,000 and 7,249,000 adults, respectively (Table 14). The difference (1,532,000 fish) was mostly between the summer-run estimates.

Using DFO's upriver estimate, gross escapements in 1993 were 1,695,000 adult sockeye above the goal (Table 14). Of the total, 6,401,000 adults reached the spawning grounds. Gross escapements of Early Stuart, early summer-, summer- and late-run stocks were 457,000 over, 60,000 under, 1,536,000 over and 238,000 under the goals, respectively.

On August 31, because of smaller than forecast returns of Fraser River pink salmon, Canada reduced the gross escapement goal for Fraser pinks from 9,605,000 to 6,105,000 fish (Table 14). The unadjusted Mission estimate of gross escapement was 3,849,000 fish, 2,256,000 under the goal, compared to the DFO estimate of 10,792,000 fish, 4,867,000 over the goal.

B. International Allocation

Achieving the international catch allocation objectives of the Treaty is the second priority of the Fraser River Panel during the fishing season. Based on preliminary estimates of a run size of 24,195,000 fish (Table 15), Canadian Add-on Escapement Benefit of 1,285,000 fish, and other deductions totalling 6,917,000 fish, the TAC in 1993 was 15,993,000 Fraser sockeye.

For 1993, the United States share of Fraser sockeye in the Panel Area was 2,756,000 fish. Estimated Washington catches totalled 2,692,000 fish, 64,000 less than the goal. Washington catches of Fraser sockeye were to be taken in proportion to the TAC's of each run, with the exception that the United States would not have directed fisheries on Early Stuart sockeye. Early summer-, summer- and late-run catches in Washington totalled 71,000, 2,397,000 and 224,000 sockeye, respectively. These catches were 29,000 over, 63,000 under and 30,000 under the goals. The Alaska catch of 182,000 Fraser sockeye was excluded from the sharing formula as agreed by the Parties.

In 1993, unusual circumstances affected the achievement of the pink salmon catch objectives. The end-of-season estimate of run-size (11,500,000 fish) was 19,500,000 fewer than the forecast return of 31,000,000. As estimates of the smaller run developed, Canada reduced the gross escapement goal from 9,500,000 to 6,105,000 fish. The TAC also decreased from 21,450,000 prior to the season to 5,450,000 at season's end. The preliminary post-season estimate of run-size is 17,009,000 Fraser River pink salmon, with an inadvertent escapement of 4,775,000 Fraser pinks and a TAC of 6,204,000 fish (Table 15). The United States caught 1,800,000 Fraser pinks, 205,000 fish over the goal of 1,595,000 fish.

Table 15. Preliminary calculations of total allowable catches and international allocations of Fraser River sockeye and pink salmon in 1993.

	<u>Sockeye</u>	<u>Pink</u>
TOTAL ALLOWABLE CATCH		
Total Run Size	24,195,000	17,009,000
Canadian Escapement Add-on Benefit	<u>1,285,000</u> *	<u>-</u>
Total Available to Share:	22,910,000	17,009,000
Deductions		
Adult Escapement	6,401,000	6,000,000
Jack Escapement	26,000	0
Inadvertent Escapement	0	4,775,000
Fraser River Indian Food Fishery Exemption	400,000	0
Test Fishing	<u>90,000</u>	<u>30,000</u>
Total Deductions:	<u>6,917,000</u>	<u>10,805,000</u>
Total Allowable Catch:	15,993,000	6,204,000
UNITED STATES		
Washington Catch	2,692,000	1,800,000
Washington Catch Goal: **	<u>2,756,000</u>	<u>1,595,000</u>
Deviation:	(64,000)	205,000
Alaska Catch	<u>182,000</u>	<u>0</u>
Total United States Catch:	2,874,000	1,800,000
CANADA		
Canadian Catch ***	<u>14,404,000</u>	<u>4,404,000</u>
TAC - (Washington Goal + Alaska Catch)	13,055,000	4,609,000
Canadian Escapement Add-on Benefit	<u>1,285,000</u> *	<u>-</u>
Canadian Share:	<u>14,340,000</u>	<u>4,609,000</u>
Deviation:	64,000	(205,000)

* Preliminary estimate based on Fraser Panel agreements (February 8, 1991 and June 24, 1993) on methodology for calculating sockeye escapement add-on benefits.

** Washington allocations according to agreement between the Parties on June 24, 1993.
 Sockeye: (20% of TAC below 12,062,000) + (10% of TAC between 12,062,000 and 15,000,000 + (5% of TAC above 15,000,000), to a maximum of 2,806,000.
 Pink: 25.7% of TAC, to a maximum of 3,600,000.

C. Domestic Allocation

The third priority of the Panel is to achieve the domestic allocation goals of the Parties. The ability of the Panel to meet this objective is somewhat limited because the Panel manages only those fisheries that occur within the Panel Area and are directed at Fraser River sockeye and pink salmon. In 1993, these included Canadian net fisheries in Areas 20 and 29, troll fisheries in Area 18-1, -4 and -11 and Area 29, United States net fisheries in Areas 4B, 5, 6, 6C, 7 and 7A and Non-Indian troll fishing in Area 4 and Area 3 north of 48°00'15"N. Canadian outside troll fisheries, including fisheries in Panel Areas 121-124, were regulated by Canada. Similarly, Indian fisheries, including ones in Panel areas, were regulated by Canada. DFO regulates fisheries in non-Panel areas (Johnstone Strait, all fisheries north of Ucluelet on the west coast of Vancouver Island and all fisheries north of Vancouver Island) with the objective of ensuring that the combined fisheries achieve the goals for escapement, international allocation and Canadian domestic allocation.

Canadian catches of Fraser River sockeye by gear type deviated from the goals set by the Minister of Fisheries (Table 16). The largest discrepancies were for gillnetters, who caught

958,000 more than their allocation of 3,980,000 sockeye (29.0% of the Canadian commercial catch) and outside trollers, who caught 593,000 sockeye less than their allocation of 2,218,000 (16.1%). Purse seiners caught 364,000 sockeye less than their allocation of 7,137,000 fish (51.9%) and inside trollers caught 1,000 less than their allocation of 412,000 sockeye (3.0%).

Table 16. Preliminary estimates of domestic overages and underages in Canadian and Washington catches of Fraser River sockeye salmon in 1993.

User Category	Actual Catches		Catch Goals		Overage/ (Underage)
	Fish	%	Fish	%	
Canada: by Gear					
Inside Troll	411,000	3.0%	412,000	3.0%	(1,000)
Outside Troll	1,625,000	11.8%	2,218,000	16.1%	(593,000)
Purse Seine	6,773,000	49.3%	7,137,000	51.9%	(364,000)
Gillnet	4,938,000	35.9%	3,980,000	29.0%	958,000
Canadian Total:	13,747,000	100.0%	13,747,000	100.0%	0
Washington: by Area or Gear					
Treaty Indian					
Areas 4B, 5 and 6C	47,000	3.4%	100,000	7.3%	(53,000)
Areas 6, 7 and 7A	1,329,000	96.6%	1,276,000	92.7%	53,000
Total:	1,376,000	100.0%	1,376,000	100.0%	0
Non-Indian					
Purse Seine	726,000	55.2%	710,000	54.0%	16,000
Gillnet	494,000	37.5%	540,000	41.0%	(46,000)
Reef Net	96,000	7.3%	66,000	5.0%	30,000
Total:	1,316,000	100.0%	1,316,000	100.0%	0
Washington: between Treaty Indian and Non-Indian Users					
Treaty Indian	1,376,000	51.1%	1,346,000	50.0%	30,000
Non-Indian	1,316,000	48.9%	1,346,000	50.0%	(30,000)
Washington Total:	2,692,000	100.0%	2,692,000	100.0%	0

The United States requested that the Panel divide the 1993 Washington catch goal for Fraser sockeye equally between Non-Indian and Treaty Indian fishing groups. Non-Indians caught 1,316,000 sockeye, 30,000 less than their allocation, and Treaty Indians caught 1,376,000 sockeye, 30,000 more than their allocation (Table 16). Treaty Indians in Areas 4B, 5 and 6C caught 47,000 sockeye, 53,000 less than their goal, while Treaty Indians in Areas 6, 7 and 7A caught 1,329,500 fish, 53,000 over their goal. Among Non-Indians, purse seiners caught 55.2% of the Non-Indian catch, gillnetters caught 37.5%, and reefnetters caught 7.3%, which represents 16,000 over, 46,000 under and 30,000 over the respective allocations for these gear.

Pink salmon allocation in Canada was for all "southerly migrating pink salmon stocks", including Fraser River, southern British Columbia and Washington State stocks. The largest discrepancy from the goals set by Canada was in the outside troll catch, which was 215,000 short of the allocation of 1,654,000 fish (Table 17). Purse seines caught 185,000 more fish than their allocation of 3,309,000. Inside trollers caught 105,000 fish more than their allocation of 228,000. Gillnetters caught 75,000 fewer pinks than their allocation of 513,000 fish.

Table 17. Preliminary estimates of domestic overages and underages in the catches of a) southerly migrating pink salmon in Canada and b) Fraser River pink salmon in the United States in 1993.

User Category	Actual Catches		Catch Goals		Overage/ (Underage)
	Fish	%	Fish	%	
a) Canada: Southerly Migrating Pink Salmon					
Inside Troll	333,000	5.8%	228,000	4.0%	105,000
Outside Troll	1,439,000	25.2%	1,654,000	29.0%	(215,000)
Purse Seine	3,494,000	61.3%	3,309,000	58.0%	185,000
Gillnet	438,000	7.7%	513,000	9.0%	(75,000)
Canadian Total:	5,704,000	100.0%	5,704,000	100.0%	0
b) United States: Fraser River Pink Salmon					
Treaty Indian	883,000	49.1%	900,000	50.0%	(17,000)
Non-Indian	917,000	50.9%	900,000	50.0%	17,000
Total:	1,800,000	100.0%	1,800,000	100.0%	0

The Fraser River pink catch was to be divided equally between Treaty-Indians and Non-Indians. Estimated catches were 883,000 pinks by Treaty Indians, 17,000 under their allocation and 917,000 by Non-Indians (includes recreational catch), 17,000 over their allocation (Table 17). The catch quota of 120,000 pink salmon in the Areas 3 and 4 Non-Indian troll fishery was not taken although weekly fishing opportunities were provided.

D. Conservation of Other Stocks

Part of the mandate of the Fraser River Panel is to accommodate the conservation and management needs of other salmon species and stocks during the management of Fraser River sockeye and pink salmon fisheries in Panel Areas. Total catches of other species and non-Fraser stocks of sockeye and pink salmon during Panel control are summarized in Table 18.

Table 18. Preliminary estimates of catches of non-Fraser sockeye and pink salmon and of other salmon species in commercial net fisheries regulated by the Fraser River Panel in 1993. *

Area	Non-Fraser				
	Sockeye	Pink	Chinook	Coho	Chum
United States					
Areas 4B, 5 and 6C Net	0	2,700	700	1,900	0
Areas 6, 7 and 7A Net	0	181,000	13,600	12,000	0
Total	0	183,700	14,300	13,900	0
Canada					
Area 20 Net	0	7,200	2,600	5,500	100
Area 29 Net	0	0	11,500	2,300	200
Total	0	7,200	14,100	7,800	300
Total Catch	0	190,900	28,400	21,700	300

* Estimates are provided by the Washington Department of Fisheries and Canada Department of Fisheries and Oceans.

The agreement that the United States would not fish Early Stuart sockeye along with conservation concerns about the Lake Washington sockeye catch in United States Areas 4B, 5 and 6C led to restricted fishing in these areas during early July. Similar concerns about coho by-catch in Areas 4B, 5 and 6C led to late-season restrictions of fisheries. Canada requested limitation of fisheries in Area 20 after September 7 to minimize the by-catch of Strait of Georgia origin coho salmon. Canada also requested that no gillnet fisheries take place in Area 29 after September 8 to reduce the by-catch of Harrison River chinook salmon and Thompson River steelhead. Although the closure period was modified to allow one fishery, it occurred at a time and in areas where low by-catches were expected. Catches of other species in all Panel Area net fisheries were very low. About 28,000 chinook, 22,000 coho and 300 chum salmon were caught. Catches of non-Fraser pink salmon totalled 191,000 fish.

X. ALLOCATION STATUS

Because international catch sharing in 1993 was an isolated, one-year-only agreement, there is no allocation status to report for either Fraser River sockeye or pink salmon.

XI. APPENDICES

APPENDIX A: 1993 PRE-SEASON FORECASTS AND ESCAPEMENT GOALS FOR FRASER RIVER SOCKEYE AND PINK SALMON. (Provided to the Panel by Canada Department of Fisheries and Oceans).

<u>Stock / Run</u>	<u>Forecast Return</u>	<u>Spawner Escapement Goal</u>	<u>Expected Catch</u>
Sockeye Salmon: by Stock			
Early Stuart	800,000	300,000	500,000
Bowron	20,000	8,000	12,000
Fennell	45,000	17,000	28,000
Raft	5,000	2,000	3,000
Pitt	50,000	19,000	31,000
Gates	150,000	50,000	100,000
Late Nadina	25,000	8,000	17,000
Chilko Lake	40,000	10,000	30,000
Scotch	36,000	9,000	27,000
Seymour	39,000	10,000	29,000
Early Miscellaneous *	23,000	6,000	17,000
Late Stuart	4,200,000	650,000	3,550,000
Horsefly	10,500,000	2,650,000	7,850,000
Chilko	400,000	101,000	299,000
Stellako	250,000	63,000	187,000
Birkenhead	325,000	125,000	200,000
Weaver	140,000	43,000	97,000
Harrison	23,000	7,000	16,000
Cultus	3,000	1,000	2,000
Portage	37,000	11,000	26,000
<u>Late Miscellaneous **</u>	<u>2,000</u>	<u>1,000</u>	<u>1,000</u>
Total Adult	17,113,000	4,091,000	13,022,000
<u>Jacks</u>	<u>247,000</u>	<u>127,000</u>	<u>120,000</u>
Total Sockeye Return	17,360,000	4,218,000	13,142,000
Sockeye Salmon: by Run			
Early Stuart	800,000	300,000	500,000
Early Summer *	433,000	139,000	294,000
Summer	15,350,000	3,464,000	11,886,000
<u>Late **</u>	<u>530,000</u>	<u>188,000</u>	<u>342,000</u>
Total Adult	17,113,000	4,091,000	13,022,000
<u>Jacks</u>	<u>247,000</u>	<u>127,000</u>	<u>120,000</u>
Total Sockeye Return	17,360,000	4,218,000	13,142,000
Pink Salmon			
Total Pink Return	31,000,000	9,500,000	21,500,000

* Includes stocks such as Upper Adams, Nahatlatch, Big Silver, etc.

** Includes stocks such as Adams, Lower Shuswap, Widgeon, etc.

APPENDIX B: 1993 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 25, 1993.

Canadian Fraser River Panel Area

In accordance with Article VI, Paragraph 5 of the Pacific Salmon Treaty, the Commission recommends to Canada the adoption of the following Fishing Regime developed by the Fraser River Panel as per Annex IV, Chapter 4 (1) (d) of the Treaty, namely:

1. a) No person shall commercially fish for sockeye or pink salmon in Pacific Fishery Management Area 20-1, 3 and 4 with nets from the 27th day of June, 1993 to the 18th day of September, 1993, both dates inclusive.
b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 20-1, 3 and 4 from the 27th day of June, 1993 to the 18th day of September, 1993, both dates inclusive.
2. a) No person shall commercially fish for sockeye or pink salmon in Pacific Fishery Management Areas 17 and 18 with nets from the 27th day of June, 1993 to the 26th day of September, 1993, both dates inclusive.
b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 18-1, 4 and 11 from the 27th day of June, 1993 to the 26th day of September, 1993, both dates inclusive.
3. a) No person shall commercially fish for sockeye or pink salmon with nets in Pacific Fishery Management Area 29 from the 27th day of June, 1993 to the 9th day of October, 1993, both dates inclusive.
b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 29 from the 27th day of June, 1993 to the 9th day of October, 1993, 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 and Area 29-5.

During the 1993 season, the Fraser River Panel will adopt Orders establishing open fishing periods based on a 1993 Management Plan (to be adopted on or about July 19, 1993). This Plan will be designed to achieve Pacific Salmon Treaty-mandated 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 as per Annex IV, Chapter 4 (1) (d) of the Treaty, namely:

Treaty Indian Fisheries:

1. No Treaty Indian shall commercially fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 4B, 5 and 6C with drift gillnets or purse seines from the 27th day of June, 1993 to the 18th day of September, 1993, both dates inclusive.
2. No Treaty Indian shall commercially fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 6, 6A, 7 and 7A with nets from the 27th day of June, 1993 to the 25th day of September, 1993, 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 26th day of September, 1993 to the 2nd day of October, 1993, both dates inclusive.

All-Citizen Fisheries:

1. No person shall troll commercially for sockeye or pink salmon in Coastal Salmon Management and Catch Reporting Area 4 and that part of Area 3 north of 48°N. latitude (Carroll Island) from the 18th day of July, 1993 to the 11th day of September, 1993, both dates inclusive.
2. No person shall fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 4B, 5, and 6C with nets from the 27th day of June, 1993 to the 18th day of September, 1993, both dates inclusive.
3. No person shall fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 6, 6A, 7 and 7A with nets from the 27th day of June, 1993 to the 25th day of September, 1993, both dates inclusive.
4. 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 26th day of September, 1993 to the 2nd day of October, 1993, both dates inclusive.

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

Treaty Indian Fisheries:

1. Coastal Salmon Management and Catch Reporting Area 4 and that Part of Area 3 north of 48°N. latitude (Carroll Island).

Treaty Indian and All-Citizen Fisheries:

1. Puget Sound Salmon Management and Catch Reporting Areas 6B, 6D, 7B, 7C, 7D and 7E.

During the 1993 season, the Fraser River Panel will adopt Orders establishing open fishing periods based on a 1993 Management Plan (to be adopted on or about July 19, 1993). This Plan will be designed to achieve Pacific Salmon Treaty-mandated international allocations of the catch and domestic goals of the Parties.

APPENDIX C: 1993 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 1993:

- July 16 Canada
Area 29-1 to 7 and 9 to 17:
 Gillnets open 8:00 a.m. July 19 to 8:00 a.m. July 20.
- Area 18-4:
 Relinquish regulatory control effective June 28.
- United States
All-Citizen Fishery
 Area 4 and Area 3 (north of 48° 00' 15" N):
 Relinquish regulatory control effective July 18 through August 7.
- July 20 Canada
Area 29-1 to 7 and 9 to 17:
 Gillnets open 8:00 a.m. July 22 to 8:00 a.m. July 23.
- July 23 Canada
Area 20-1, 3 and 4:
 Gillnets open 6:00 p.m. July 25 to 8:00 a.m. July 27.
- Area 29-1 to 7 and 9 to 17:
 Gillnets open 8:00 a.m. July 25 to 8:00 a.m. July 26.
- United States
Treaty Indian Fishery
 Areas 4B, 5, and 6C:
 Drift gillnets open 12:00 p.m. (noon) July 26 to 12:00 p.m. (noon) July 30.
- July 30 Canada
Area 20-1, 3 and 4:
 Purse seines open 7:00 a.m. to 7:00 p.m. August 3.
 Gillnets open 7:00 p.m. August 3 to 8:00 a.m. August 4, 7:00 p.m. August 4 to 8:00 a.m. August 5,
 and 7:00 p.m. August 5 to 8:00 a.m. August 6.
- Area 29-1 to 7 and 9 to 17:
 Gillnets open 8:00 a.m. August 1 to 8:00 a.m. August 2.
- United States
Treaty Indian Fishery
 Areas 4B, 5, and 6C:
 Drift gillnets extended from 12:00 p.m. (noon) July 30 to 12:00 p.m. (noon) August 6.
- Areas 6, 7 and 7A:
 Open to net fishing 5:00 a.m. August 2 to 9:00 a.m. August 3.
- All-Citizen Fishery
 Areas 6, 7 and 7A:
 Gillnets open 12:00 p.m. (noon) to 12:00 a.m. (midnight) August 3.
 Purse seines open 5:00 a.m. to 9:00 p.m. August 4.
 Reefnets open 5:00 a.m. to 9:00 p.m. August 1 and August 3.

August 2 Canada
Area 20-1, 3 and 4:
Cancel gillnet fishing previously scheduled for 7:00 p.m. August 5 to 8:00 a.m. August 6.

Area 29-1 to 4 and 6 and Area 18-1 and 11:
Open to commercial trolling from 12:01 a.m. August 7, to 11:59 p.m. August 8.

Area 18-4:
Open to commercial trolling 12:01 a.m. August 7, until further notice.

United States
All-Citizen Fishery
Areas 6, 7 and 7A:
Reefnets open 5:00 a.m. to 9:00 p.m. August 5.

August 6 Canada
Area 20-1, 3 and 4:
Purse seines open 7:00 a.m. to 7:00 p.m. August 10.
Gillnets open 7:00 p.m. August 10, to 8:00 a.m. August 11, 7:00 p.m. August 11, to 8:00 a.m. August 12, and 7:00 p.m. August 12, to 8:00 a.m. August 13.

Area 29-1 to 7 and 9 to 17:
Gillnets open 8:00 a.m. August 10, to 8:00 a.m. August 11.

United States:
Treaty Indian Fishery
Areas 4B, 5, and 6C:
Drift gillnets extended from 12:00 p.m. (noon) August 6, to 12:00 p.m. (noon) August 11.

Areas 6, 7 and 7A:
Open to net fishing 6:00 p.m. August 8, to 9:00 p.m. August 10.

All-Citizen Fishery
Areas 6, 7 and 7A:
Gillnets open 12:00 p.m. (noon) August 11, to 7:00 a.m. August 12.
Purse seines open 5:00 a.m. to 9:00 p.m. August 12.

Area 4 and Area 3 north of 48° 00' 15" N:
Open to commercial trolling 12:01 a.m. August 8, until further notice.

August 10 United States
Treaty Indian Fishery
Areas 4B, 5, and 6C:
Drift gillnets extended from 12:00 p.m. (noon) August 11, to 12:00 p.m. (noon) August 14.

August 12 Canada
Area 18-4:
Close to commercial trolling 11:59 p.m. August 13. Re-open for commercial trolling 12:01 a.m. August 16 until further notice.

United States
Treaty Indian Fishery
Areas 4B, 5, and 6C:
Drift gillnets extended from 12:00 p.m. (noon) August 14 to 12:00 p.m. (noon) August 18.

Areas 6, 7 and 7A:
Open to net fishing from 11:00 a.m. August 13 to 11:00 a.m. August 17.

August 13 Canada
Area 29-1 to 7 and 9 to 17:
Gillnets open 8:00 a.m. August 16 to 8:00 a.m. August 17.

United States
All-Citizen Fishery
Areas 6, 7 and 7A:
Reefnets open 5:00 a.m. to 9:00 p.m. August 15 and August 17. Gillnets open 12:00 p.m. (noon) August 17 to 7:00 a.m. August 18, and 7:00 p.m. August 18 to 9:00 a.m. August 19.
Purse seines open 5:00 a.m. to 9:00 p.m. August 18 and August 19.

- August 17 Canada
 Area 29-1 to 7 and 9 to 17:
 Gillnets open 8:00 a.m. August 18 to 8:00 a.m. August 19.
- Area 18-4:
 Close to commercial trolling 11:59 p.m. August 17.
- United States
 Treaty Indian Fishery
 Areas 4B, 5 and 6C:
 Drift gillnets extended from 12:00 p.m. (noon) August 18, to 12:00 p.m. (noon) August 21.
- All-Citizen Fishery
 Areas 6, 7 and 7A:
 Cancel the previously scheduled fishery for purse seines from 5:00 a.m. to 9:00 p.m. August 19.
 Reefnets open 5:00 a.m. to 9:00 p.m. August 18 and August 19.
- August 19 United States
 Treaty Indian Fishery
 Areas 6, 7, and 7A:
 Open to net fishing 6:00 p.m. August 19, to 9:00 p.m. August 21.
- August 20 United States
 Treaty Indian Fishery
 Areas 4B, 5 and 6C:
 Drift gillnets extended from 12:00 p.m. (noon) August 21 to 12:00 p.m. (noon) August 28.
- Areas 6, 7 and 7A:
 Net fishing extended from 9:00 p.m. August 21, to 9:00 a.m. August 22.
- All-Citizen Fishery
 Areas 7 and 7A:
 Reef nets open 5:00 a.m. to 9:00 p.m. August 21, August 22 and August 24.
 Gillnets open 12:00 p.m. (noon) to 12:00 a.m. (midnight) August 22 and 7:00 p.m. August 23 to 9:00 a.m. August 24.
 Purse seines open 5:00 a.m. to 9:00 p.m. August 23 and August 24.
- August 24 United States
 Treaty Indian Fishery
 Areas 6, 7 and 7A:
 Open to net fishing 9:00 p.m. August 25, to 9:00 p.m. August 28.
- All-Citizen Fishery
 Areas 7 and 7A:
 Gillnets open 7:00 p.m. August 24, to 9:00 a.m. August 25.
 Purse seines open 5:00 a.m. to 9:00 p.m. August 25. Reefnets open 5:00 a.m. to 9:00 p.m. August 25 and August 26.
- August 27 Canada
 Area 29-1 to 3, 7 and 9 to 17 and those portions of 4, 5 and 6 lying northerly and westerly of a line drawn from Canoe Pass light through the point of the Apex of the International Boundary to the Galiano Island shore:
 Gillnets open 8:00 a.m. August 30, to 8:00 a.m. August 31.
- Area 29-1 to 4 and 6 and Area 18-1 and 11:
 Open to commercial trolling 12:01 a.m. to 11:59 p.m. August 29.
- Area 18-4:
 Open to commercial trolling 12:01 a.m. August 29, until further notice.
- United States
 Treaty Indian Fishery
 Areas 4B, 5 and 6C:
 Drift gillnets extended from 12:00 p.m. (noon) August 28, to 12:00 p.m. (noon) September 5.
- Areas 6, 7 and 7A:
 Net fishing extended from 9:00 p.m. August 28, to 9:00 a.m. August 29 and re-open to net fishing 9:00 p.m. August 30, to 9:00 p.m. August 31.

- All-Citizen Fishery
Area 7 and 7A:
Gillnets open 12:00 p.m. (noon) August 29, to 9:00 a.m. August 30. Purse seines open 5:00 a.m. to 9:00 p.m. August 30. Reef nets open 5:00 a.m. to 9:00 p.m. August 28; August 29; and August 30.
- August 30 Canada
Area 29-1 to 3, 7 and 9 to 17 and those portions of 4, 5 and 6 lying northerly and westerly of a line drawn from Canoe Pass light through the point of the Apex of the International Boundary to the Galiano Island shore:
Gillnets extended from 8:00 a.m. to 8:00 p.m. August 31.
- Area 29-1 to 4 and 6 and Area 18-1 and 11:
Open to commercial trolling 12:01 a.m. August 31, until further notice.
- August 31 United States
Treaty Indian Fishery
Areas 6, 7 and 7A:
Net fishing extended from 9:00 p.m. August 31, to 9:00 a.m. September 3.
- All-Citizen Fishery
Area 7 and 7A:
Gillnets open 12:00 p.m. (noon) September 3, to 9:00 a.m. September 4.
- September 1 Canada
Area 29-1 to 3, 7 and 9 to 17 and those portions of 4, 5 and 6 lying northerly and westerly of a line drawn from Canoe Pass light through the point of the Apex of the International Boundary to the Galiano Island shore:
Gillnets open 12:00 p.m. (noon) September 2 to 12:00 p.m. (noon) September 3.
- September 3 Canada
Area 29-1 to 7 and 9 to 17:
Gillnets open 8:00 a.m. September 7 to 8:00 a.m. September 8.
- United States
Treaty Indian Fishery
Areas 6, 7 and 7A:
Open to net fishing 5:00 a.m. September 6, to 8:00 a.m. September 7.
- All-Citizen Fishery
Areas 7 and 7A:
Gillnets extended from 9:00 a.m. September 4 to 7:00 p.m. September 5.
Purse seines open 8:00 a.m. to 9:00 p.m. September 7.
- September 7 Canada
Area 29-1 to 7 and 9 to 17:
Re-open for gillnets 8:00 a.m. September 9 to 8:00 a.m. September 10.
- September 10 Canada
Area 20:
Relinquish regulatory control effective 11:59 p.m. September 11.
- United States
Treaty Indian and All-Citizen Fishery
Areas 4B, 5 and 6C:
Relinquish regulatory control effective 11:59 p.m. September 11.
- September 14 Canada
Area 29-1 to 4 and 6 and Area 18-1, 4 and 11:
Close to commercial trolling at 11:59 p.m. September 18.

The Fraser River Panel relinquished regulatory control of the remaining Panel Areas on October 14, as scheduled. This completed the Panel's responsibility in the Panel Area for the 1993 fishing season.

All times herein cited are Pacific Daylight Savings Time.

APPENDIX D: TABLES 1-9

Table 1. Commercial net catches of Fraser River sockeye salmon in Canadian Area 20 (Juan de Fuca Strait) by week for cycle years 1981-1993.

Date *	1981	1985	1989	1993
Jun. 20-Jun. 26	0	0	0	0
Jun. 27-Jul. 3	0	0	0	0
Jul. 4-Jul. 10	0	0	0	0
Jul. 11-Jul. 17	0	0	0	0
Jul. 18-Jul. 24	0	0	17,000	0
Jul. 25-Jul. 31	0	0	0	10,000
Aug. 1-Aug. 7	88,000	587,000	266,000	136,000
Aug. 8-Aug. 14	46,000	877,000	570,000	314,000
Aug. 15-Aug. 21	28,000	945,000	1,399,000	0
Aug. 22-Aug. 28	37,000	134,000	826,000	0
Aug. 29-Sep. 4	37,000	56,000	198,000	0
Sep. 5-Sep. 11	13,000	9,000	9,000	0
Sep. 12-Sep. 18	3,000	3,000	1,000	0
Sep. 19-Sep. 25	0	0	0	0
Sep. 26-Oct. 2	0	0	0	0
Total	252,000	2,611,000	3,286,000	460,000

* Dates for 1993. For other years, data from the nearest week was used.

Table 2. Commercial net and troll catches of Fraser River sockeye salmon in Canadian Areas 17, 18 and 29 (Strait of Georgia and lower Fraser River) by week for cycle years 1981-1993.

Date *	1981	1985	1989	1993
Jun. 20-Jun. 26	0	0	0	0
Jun. 27-Jul. 3	0	0	0	0
Jul. 4-Jul. 10	46,000	0	96,000	0
Jul. 11-Jul. 17	42,000	0	267,000	0
Jul. 18-Jul. 24	31,000	0	50,000	141,000
Jul. 25-Jul. 31	30,000	53,000	0	50,000
Aug. 1-Aug. 7	32,000	204,000	108,000	60,000
Aug. 8-Aug. 14	256,000	334,000	130,000	164,000
Aug. 15-Aug. 21	103,000	171,000	436,000	260,000
Aug. 22-Aug. 28	221,000	313,000	965,000	0
Aug. 29-Sep. 4	34,000	286,000	416,000	1,970,000
Sep. 5-Sep. 11	22,000	21,000	12,000	74,000
Sep. 12-Sep. 18	7,000	11,000	2,000	30,000
Sep. 19-Sep. 25	4,000	5,000	0	10,000
Sep. 26-Oct. 2	0	4,000	3,000	8,000
Total	828,000	1,402,000	2,485,000	2,767,000

* Dates for 1993. For other years, data from the nearest week was used.

Table 3. Commercial troll landings of Fraser River sockeye salmon in Canadian Areas 121 to 127 (west coast of Vancouver Island) by week for cycle years 1981-1993. The landing dates shown lag an average of five days behind catch dates.

Date *	1981	1985	1989	1993
Jun. 20-Jun. 26	0	0	0	0
Jun. 27-Jul. 3	0	0	0	0
Jul. 4-Jul. 10	0	0	11,000	0
Jul. 11-Jul. 17	1,000	4,000	15,000	0
Jul. 18-Jul. 24	1,000	4,000	2,000	0
Jul. 25-Jul. 31	1,000	19,000	42,000	0
Aug. 1-Aug. 7	1,000	164,000	223,000	3,000
Aug. 8-Aug. 14	11,000	407,000	450,000	352,000
Aug. 15-Aug. 21	7,000	249,000	16,000	253,000
Aug. 22-Aug. 28	11,000	87,000	136,000	0
Aug. 29-Sep. 4	4,000	31,000	143,000	7,000
Sep. 5-Sep. 11	1,000	8,000	9,000	5,000
Sep. 12-Sep. 18	0	2,000	0	4,000
Sep. 19-Sep. 25	1,000	2,000	0	0
Sep. 26-Oct. 2	0	0	0	1,000
Total	39,000	977,000	1,047,000	625,000

* Dates for 1993. For other years, data from the nearest week was used.

Table 4. Commercial net and troll catches of Fraser River sockeye salmon in Canadian Areas 11 to 16 (Johnstone Strait and northern Strait of Georgia) by week for cycle years 1981-1993.

Date *	1981	1985	1989	1993
Jun. 20-Jun. 26	0	0	0	0
Jun. 27-Jul. 3	8,000	0	0	0
Jul. 4-Jul. 10	33,000	0	4,000	0
Jul. 11-Jul. 17	43,000	1,000	30,000	0
Jul. 18-Jul. 24	29,000	9,000	40,000	20,000
Jul. 25-Jul. 31	183,000	109,000	161,000	29,000
Aug. 1-Aug. 7	700,000	451,000	776,000	477,000
Aug. 8-Aug. 14	875,000	445,000	973,000	3,503,000
Aug. 15-Aug. 21	876,000	1,160,000	2,038,000	2,904,000
Aug. 22-Aug. 28	371,000	638,000	621,000	252,000
Aug. 29-Sep. 4	113,000	261,000	265,000	1,285,000
Sep. 5-Sep. 11	23,000	54,000	61,000	184,000
Sep. 12-Sep. 18	14,000	19,000	15,000	21,000
Sep. 19-Sep. 25	2,000	3,000	0	8,000
Sep. 26-Oct. 2	0	0	0	1,000
Total	3,270,000	3,150,000	4,984,000	8,684,000

* Dates for 1993. For other years, data from the nearest week was used.

Table 5. Catches of Fraser River sockeye salmon in the Canadian Fraser River Indian fishery by area (Fraser River mainstream or tributary areas) for cycle years 1981-1993. *

<u>Fishing Area</u>	<u>1981</u>	<u>1985</u>	<u>1989</u>	<u>1993</u>
<u>Fraser River Mainstem</u>				
Steveston	8,677	19,721	28,497	139,311
Deas to Mission	7,088	6,624	10,371	57,185
Mission to Hope	82,536	74,959	153,240	189,584
Hope to Sawmill Creek	58,828 **	113,605 **	132,549 **	254,939
Sawmill Creek to Churn Creek	134,455 **	100,330 **	146,764 **	134,167
Churn Creek to Hixon	71,660	55,432	59,514	42,407
<u>Above Hixon</u>	<u>4,775</u>	<u>6,887</u>	<u>3,178</u>	<u>2,593</u>
Total	368,019	377,558	534,113	820,186
<u>Tributaries</u>				
Harrison/Lillooet System	5,010	3,024	3,161	0
Thompson System	150	100	485	142
Chilcotin System	31,350	8,990	11,300	16,477
Nechako System	16,452	18,402	11,118	3,402
<u>Stuart System</u>	<u>19,683</u>	<u>16,425</u>	<u>11,766</u>	<u>7,849</u>
Total	72,645	46,941	37,830	27,870
Total Catch	440,664	424,499	571,943	848,056

* Data supplied by DFO.

** Prior to 1993, the divisions were Hope to North Bend, and North Bend to Churn Creek.

Table 6. Commercial net catches of Fraser River sockeye salmon in United States Areas 4B, 5, 6, 6C, 7, 7A and 7B (Juan de Fuca Strait and northern Puget Sound) by week for cycle years 1981-1993.

<u>Date *</u>	<u>1981</u>	<u>1985</u>	<u>1989</u>	<u>1993</u>
Jun. 20-Jun. 26	0	0	0	0
Jun. 27-Jul. 3	0	0	17,000	0
Jul. 4-Jul. 10	4,000	3,000	119,000	0
Jul. 11-Jul. 17	181,000	0	26,000	0
Jul. 18-Jul. 24	49,000	1,000	49,000	0
Jul. 25-Jul. 31	102,000	174,000	0	4,000
Aug. 1-Aug. 7	141,000	538,000	205,000	235,000
Aug. 8-Aug. 14	201,000	654,000	872,000	672,000
Aug. 15-Aug. 21	421,000	921,000	598,000	909,000
Aug. 22-Aug. 28	96,000	282,000	128,000	343,000
Aug. 29-Sep. 4	69,000	253,000	183,000	495,000
Sep. 5-Sep. 11	18,000	48,000	41,000	34,000
Sep. 12-Sep. 18	2,000	13,000	10,000	0
Sep. 19-Sep. 25	2,000	1,000	0	0
<u>Sep. 26-Oct. 2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	1,286,000	2,888,000	2,248,000	2,692,000

* Dates for 1993. For other years, data from the nearest week was used.

Table 7. Escapements of sockeye salmon to Fraser River spawning areas for cycle years 1981, 1985, 1989 and 1993. *

DISTRICT Stream/Lake	1993 Period of Peak Spawning	Estimated Number of Adult Sockeye				Jacks
		1981	1985	1989	1993	1993
NORTHEAST						
Upper Bowron River	-	1,170	6,419	2,534	1,184	0
STUART						
<u>Early Runs</u>						
Driftwood River	Aug. 1-10	47,298	93,959	250,301	448,359	0
Takla Lake Streams	Aug. 1-15	29,588	42,192	54,937	214,708	0
Middle River Streams	Aug. 1-10	44,410	72,856	47,876	121,916	2
Trembleur Lake Streams	Aug. 1-10	8,161	25,512	31,685	102,158	0
Early Stuart Total		129,457	234,519	384,799	887,141	1
<u>Late Runs</u>						
Kazchek Creek	Sep.25-Oct.5	6,872	1,955	767	8,568	0
Kuzkwa Creek	Sep.25-Oct.5	20,520	2,624	4,122	51,779	0
Middle River	Sep.25-Oct.5	125,625	114,115	276,131	388,937	9
Tachie River	Sep.25-Oct.5	93,850	155,641	287,290	1,339,755	164
Miscellaneous	Sep.25-Oct.5	2,627	286	7,387	15,930	0
Late Stuart Total		249,494	274,621	575,697	1,804,969	173
NECHAKO						
Nadina River (Late)	Sep.17-21	1,024	1,516	545	1,000	0
Nadina Channel	Sep.17-21	17,888	12,291	4,395	8,595	0
Stellako River	Sep.25-Oct.1	21,826	42,099	43,179	91,071	372
QUESNEL						
Upper Horsefly River	Sep.16-23	452,909	762,261	658,452	1,649,829	254
Lower Horsefly River	Sep.16-23	119,690	274,991	814,818	-	2
Horsefly Channel	-	-	-	23,300	17,891	0
McKinley Creek	Sep.16-23	104,761	97,552	117,830	169,368	4
Mitchell River	Sep.15-26	66,106	207,041	240,521	725,030	36
Miscellaneous	Sep.18-27	-	-	15,899	58,336	9
Quesnel Total		743,466	1,341,845	1,870,820	2,620,454	303
CHILCOTIN						
Chilko River	Sep.25-30	34,360	71,435	51,580	549,845	6,621
Chilko Channel	Sep.17-25	-	-	1,459	5,381	18
Chilko Lake-South End	-	180	540	10,229	-	3
SETON-ANDERSON						
Gates Creek	Sep.6-10	774	662	2,968	1,188	32
Gates Channel	Sep.7-10	3,896	3,916	13,995	16,764	644
Portage Creek	Nov.10-16	5,855	1,765	7,900	19,760	0
NORTH THOMPSON						
Raft River	Sep.1-8	815	3,638	1,647	5,047	0
Fennell Creek	Aug.25-Sep.1	2,076	1,598	3,988	7,546	0
SOUTH THOMPSON						
<u>Summer Runs</u>						
Seymour River	Aug.31-Sep.7	11,359	5,620	5,507	10,114	87
Scotch Creek	Aug.30-Sep.6	18,952	3,385	7,236	8,359	169
<u>Late Runs</u>						
Adams River	Oct.10-18	5,242	422	73	540	7,609
Lower Shuswap River	Oct.16-22	4,075	817	488	745	1,991
HARRISON-LILLOOET						
Birkenhead River	late Sep.	49,023	11,905	29,334	244,954	5,471
Harrison River	Nov.12-16	3,193	5,097	2,934	3,258	7
Weaver Creek	Oct.20-Nov.10	23,287	17,009	4,864	34,555	959
Weaver Channel	Oct.20-Nov.10	18,715	20,010	12,303	49,901	736
LOWER FRASER						
Nahatlatch River/Lakes	Sep.1-4	786	1,257	3,628	2,078	0
Cultus Lake	Dec.10-20	256	424	418	1,063	68
Upper Pitt River	Sep.10-14	25,327	3,560	16,037	22,835	15
MISCELLANEOUS						
ADULTS		1,384,102	2,077,686	3,060,120	6,401,501	25,724
JACKS		58,573	60,914	47,337	25,724	
TOTAL NET ESCAPEMENT		1,442,675	2,138,600	3,107,457	6,427,225	

* 1981 and 1985 data are from the PSC. Estimates for 1989 and 1993 are from DFO.

1 Early Stuart estimates are subject to further review.

2 Lower Horsefly River spawners included in Upper Horsefly River estimates.

3 South-end Chilko Lake spawners included in Chilko River total.

Table 8. Escapements of pink salmon to Fraser River spawning areas for cycle years 1987, 1989, 1991 and 1993, from Canada Department of Fisheries and Oceans. Spawner abundances for individual spawning areas in the Fraser River watershed were not available in 1993.

RUN				
<u>DISTRICT</u>	<u>Estimated Number of Pink Salmon</u>			
<u>River/Stream</u>	<u>1987</u>	<u>1989</u>	<u>1991</u>	<u>1993</u>
EARLY RUNS				
<u>LOWER FRASER</u>				
Main Fraser	1,065,710	4,780,703	9,281,051	
<u>Ruby Creek</u>	<u>-</u>	<u>-</u>	<u>6,783</u>	
Total	1,065,710	4,780,703	9,287,834	N/A
<u>FRASER CANYON</u>				
Coquihalla River	6,029	13,559	71,555	
Jones Creek	1,404	4,958	3,558	
Nahatlatch River	1,170	9,334	35,100	
<u>Miscellaneous Tributaries</u>	<u>3,455</u>	<u>13,194</u>	<u>18,333</u>	
Total	12,058	41,045	128,546	N/A
<u>SETON-ANDERSON</u>				
Seton Creek	627,966	872,460	1,272,395	
Upper Seton Channel	13,060	21,522	13,056	
Lower Seton Channel	36,696	40,041	32,059	
Cayoosh Creek	-	-	87,388	
Portage Creek	21,117	21,096	29,008	
Bridge River	44,200	104,000	184,327	
<u>Gates Creek</u>	<u>247</u>	<u>372</u>	<u>595</u>	
Total	743,286	1,059,491	1,618,828	N/A
<u>THOMPSON</u>				
Thompson River and Tributaries	253,109	281,640	769,800	N/A
<u>UPPER FRASER TRIBUTARIES</u>				
	<u>496</u>	<u>6,535</u>	<u>2,309</u>	<u>N/A</u>
EARLY-RUN TOTAL	2,074,659	6,169,414	11,807,317	N/A
LATE RUNS				
<u>LOWER FRASER TRIBUTARIES</u>				
	1,359	1,056	6,929	N/A
<u>HARRISON</u>				
Harrison River	1,028,892	681,572	947,812	
Weaver Creek	5,212	3,315	12,419	
<u>Weaver Channel</u>	<u>1,168</u>	<u>2,493</u>	<u>2,391</u>	
Total	1,035,272	687,380	962,622	N/A
<u>CHILLIWACK-VEDDER</u>				
Chilliwack-Vedder Rivers	106,410	328,020	158,876	
<u>Sweltzer Creek</u>	<u>5,467</u>	<u>3,290</u>	<u>5,364</u>	
Total	111,877	331,310	164,240	N/A
<u>MISCELLANEOUS</u>				
	<u>354</u>	<u>26</u>	<u>8,210</u>	
LATE-RUN TOTAL	<u>1,148,862</u>	<u>1,019,772</u>	<u>1,142,001</u>	<u>N/A</u>
TOTAL NET ESCAPEMENT	3,223,521	7,189,186	12,949,318	10,774,681

Table 9. Fraser River pink salmon production for odd years, 1961-1991.

Brood Year	Spawners		Potential Egg	Fry	Adult Returns (Catch +	% Survival	
	Total (millions)	Female (millions)	Deposition (millions)	Production (millions)	Escapement) (millions)	Freshwater	Marine
1961	1.094	0.654	1,569	143.6	5.477	9.2%	3.8%
1963	1.953	1.216	2,435	284.2	2.320	11.7%	0.8%
1965	1.191	0.692	1,488	274.0	12.968	18.4%	4.7%
1967	1.831	0.973	2,132	237.6	3.928	11.1%	1.7%
1969	1.529	0.957	2,018	195.6	9.767	9.7%	5.0%
1971	1.804	1.096	1,923	245.4	6.789	12.8%	2.8%
1973	1.754	1.009	1,865	292.4	4.894	15.7%	1.7%
1975	1.367	0.781	1,493	279.2	8.209	18.7%	2.9%
1977	2.388	1.362	2,960	473.3	14.404	16.0%	3.0%
1979	3.561	2.076	3,787	341.5	18.685	9.0%	5.5%
1981	4.488	2.560	4,814	590.2	15.346	12.3%	2.6%
1983	4.632	2.931	4,702	554.8	19.104	11.8%	3.4%
1985	6.461	3.561	5,900	256.1	7.172	4.3%	2.8%
1987	3.224	1.845	3,471	406.9	16.631	11.7%	4.1%
1989	7.189	4.374	7,152	360.0	22.333	5.0%	6.2%
1991	12.943	8.002	12,330	697.0	17.009	5.7%	2.4%
Average	3.588	2.131	3,752	352.0	11.565	11.4%	3.3%

APPENDIX E: STAFF OF THE PACIFIC SALMON COMMISSION IN 1993

EXECUTIVE OFFICE

Mr. I. Todd, Executive Secretary
Ms. J. Abramson, Secretary
Mrs. V. Ryall, Meeting Planner
Ms. T. Tarita, Librarian/Records Administrator

FINANCE AND ADMINISTRATION

Mr. K. Medlock, Comptroller
Ms. B. Dalziel, Accountant

FISHERIES MANAGEMENT DIVISION STAFF

Dr. J. Woodey, Chief

BIOMETRICS / CATCH STATISTICS GROUP

Mr. I. Guthrie, Head
Mr. D. Stelter, Catch Statistician

COMPUTER SERVICES GROUP

Ms. K. Mulholland, Computer System Manager

RACIAL IDENTIFICATION GROUP

Mr. J. Gable, Head
Mr. M. Lapointe, Sockeye Racial Analysis Biologist
Mr. B. White, Pink Racial Analysis Biologist
Ms. C. Lidstone, Senior Scale Analyst
Ms. J. Parkin, Scale Analyst
Ms. H. Derham, Scale Lab Assistant
Mr. K. Forrest, Racial Data Biologist (Term)

STOCK MONITORING GROUP

Mr. J. Cave, Head
Mr. P. Cheng, Hydroacoustics Biologist
Ms. V. Craig, Test Fishing Biologist