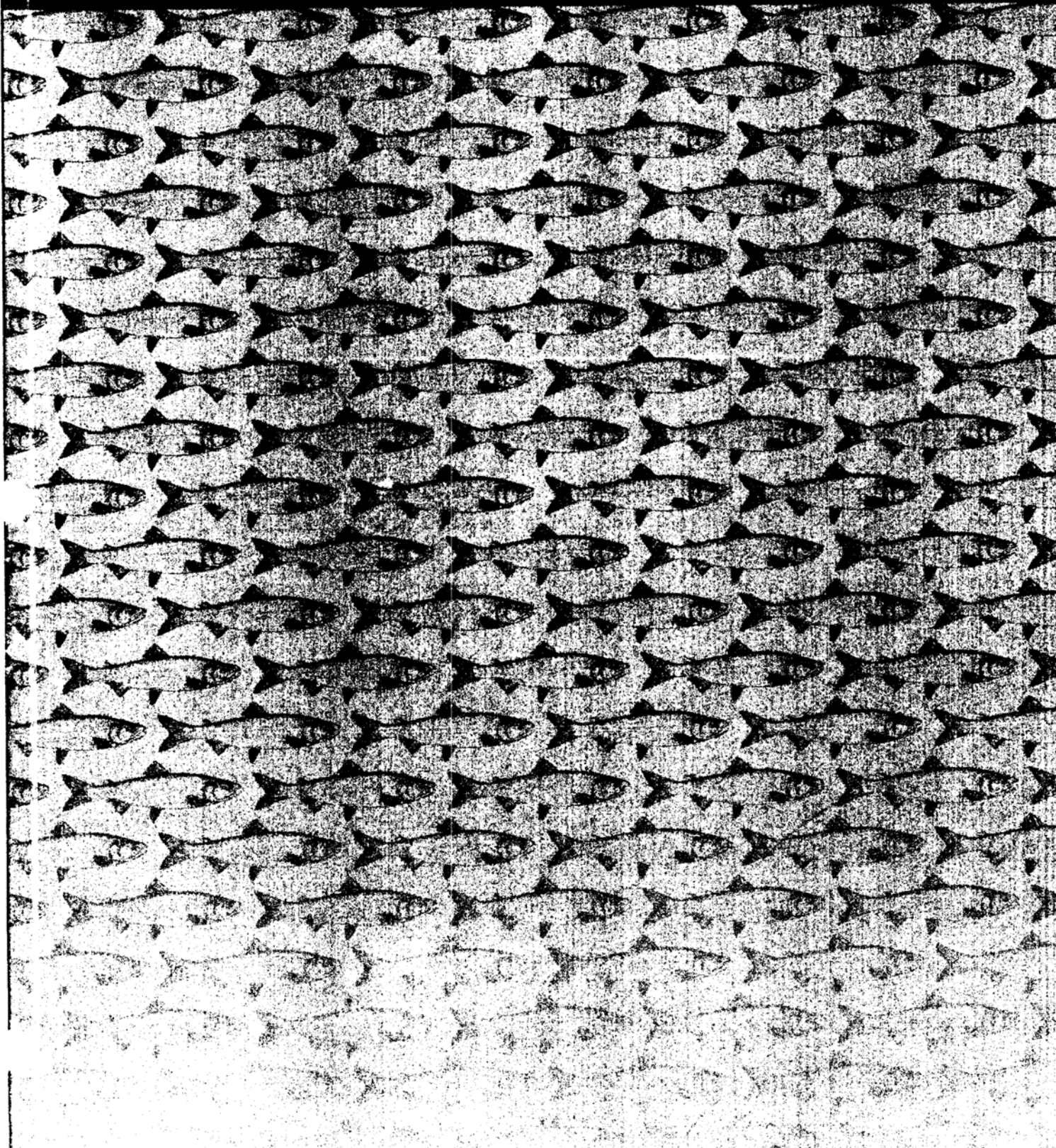


MANAGING SALMON IN THE FRASER

Report to the Minister of Fisheries and Oceans on the Fraser River Salmon Investigation

Peter H. Pearse

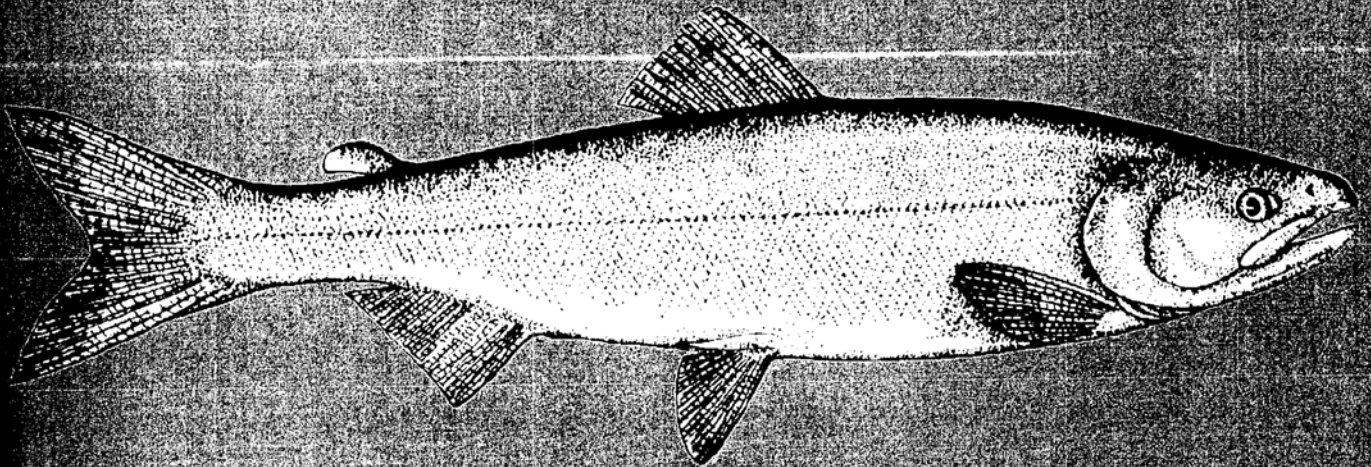
With Scientific and Technical Advice from Peter A. Larkin



Contents

Preface	1
Executive Summary	3
Chapter 1 Introduction	4
Chapter 2 1992 Fraser River Salmon Fishery	5
Chapter 3 Indian Fisheries Experiment	11
Chapter 4 The Missing Sockeye: Possibilities and Probabilities	21
Chapter 5 Lessons for the Future	29

IN THE SUMMER OF 1992, EARLY RUNS OF SOCKEYE SALMON REACHED THEIR spawning grounds in the upper reaches of the Fraser River in much smaller numbers than expected, giving rise to considerable anxiety and debate. On September 17, the Minister of Fisheries and Oceans, the Honorable John Crosbie, appointed me as an independent adviser to conduct an investigation into the reasons for this short fall and to recommend any corrective measures needed for the future. He also appointed Dr. Peter A. Larkin as my scientific and technical adviser.



My terms of reference were to provide direction to the special investigation teams within the Department of Fisheries and Oceans to ensure we obtained all helpful information and analysis. I was also asked to consult with representatives of the various interest groups in the fishery.

During this two-month investigation Dr. Larkin and I interviewed many knowledgeable people associated with the fisheries on the coast and in the interior. We reviewed and analysed a large volume of statistical information and other documentation about the salmon resources of the Fraser River, the way they are managed and the way they are fished. We had lengthy discussions with fisheries management officials based in Ottawa, Vancouver, Victoria and in the field. We visited river fisheries by car and aircraft.

PREFACE

The team of investigators organized by the Department consisted of more than 50 experts in surveillance and enforcement, hydro-acoustics, biology and biometrics. They provided us with a great deal of technical information and analysis and responded to our special requests.

We met with representatives of the fishing industry, commercial fishermen, sport fishermen and Indians, many of whom prepared helpful briefs and other documentation. Many individuals, some of whom were not directly involved in the fishery but who were concerned about the salmon or witnessed events on the river last summer, also spoke and wrote to us.

We found widespread anxiety about the apparent depletion of Fraser salmon and an eagerness to ensure our investigation would lead to improvements. Accordingly, we encountered enthusiastic co-operation from all sides, including the agencies of the federal and provincial governments and the Pacific Salmon Commission. Our report owes much to their help.

The accusations and debate which followed reports of salmon having disappeared last summer created a strained atmosphere in which we found it most productive to conduct our interviews flexibly, with groups or individuals as they chose. Many people wanted to talk to us in confidence. We had free access to all personnel in the Department and to information they could provide. The support and co-operation we met in carrying out this work contrasted sharply with the nameless debate surrounding the issue we were to investigate.

Because of the contentious atmosphere surrounding the issues in this report, I wish to stress at the outset that my task has been to explain, as far as can be explained, what happened to the salmon. I have not sought to find culprits or assign blame, though some responsibility for events is implied in my conclusions. It is more important now to assess what went wrong and, with a view to the future, identify the changes needed to improve the way we manage and use the precious salmon resources of the Fraser River.



Peter H. Pearse, C.M.

Vancouver

November, 1992

IN THE SUMMER OF 1992, about 482,000 sockeye salmon seemed to disappear on their way to spawning grounds in the Fraser River system. Careful checks of the hydro-acoustic counting system at Mission suggest this discrepancy cannot be attributed to over-estimates of the number of fish entering the river. Normal natural mortality was not adequately accounted for in official estimates and the number having reached their spawning beds was probably under-estimated, but these could account for only a fraction of the missing fish.

The investigation concludes that the shortfall in spawners was due mainly to unusually intensive fishing in the river last summer. Catches on the lower river and up through the canyon probably exceeded estimates by about 200,000 fish. Significant losses can also be attributed to fishing-induced mortality – dead fish dropping out of nets and fish dying of stress after escaping from nets.

The Indian fishery on the lower river was organized under agreements, which for the first time specified the numbers of fish that the Indian communities were authorized to catch and also permitted these catches to be sold. The experiment worked well in some places but not others. It also invited abuse of fishing rights outside the agreement area.

Failure to achieve escapement targets last summer was not a disaster, but the program of rebuilding sockeye stocks – especially the Early Stuart stock – has suffered a setback. It cannot be repeated without seriously threatening salmon resources. Major changes are needed in order to reconcile co-operative management with resource conservation and development.

THE 1992 FISHING season on the Fraser River began with high expectations.

It promised to be an important year for salmon management. Historically, the 1992 cycle year for Fraser salmon produces the smallest runs of the four cycles, but some stocks were expected to return in record numbers as a result of a long-term stock rebuilding program. It was also an important year for fisheries policy. Federal fisheries authorities, prodded by recent court rulings about aboriginal fishing rights, negotiated agreements with several Indian communities in B.C., including some on the lower Fraser, that specified for the first time how many fish these communities were authorized to take in their traditional river fisheries and also permitted them to sell their catch.

But even before the salmon reached the coast, trouble began.

First, the Pacific Salmon Commission (the Commission) failed to agree on how the commercial catch at sea would be divided between Canadian and U.S. fishermen. This meant Canadian and U.S. fisheries authorities designed independent plans for fishing stocks bound for the Fraser, raising the prospect of a "fish war".

The next disappointment was the size of the returning stocks. The first of the several runs of sockeye salmon expected in 1992 – the famous Early Stuart run (named after the Stuart River and lakes in the northern interior where this stock spawns) – was expected to arrive in record numbers. But as the Early Stuart stock entered the fishing grounds of Juan de Fuca and Johnstone Straits, the estimated stock size was only half the size expected.

The reduced number of fish was now insufficient to meet the targeted number of spawners and the expected catch in Indian fisheries along the river, and still provide a commercial catch. Accordingly, commercial fishing in both Canada and the U.S. was closed while Early Stuart sockeye passed into the river.

As counts of the fish entering the river came in, the Early Stuart stock size was further lowered. If Indian fisheries took the expected number, the escapement target was now not likely to be met. The next sockeye stocks to arrive – the Early Summer group – also turned up in smaller numbers than expected.

Then, alarming news came from the spawning grounds: arrivals of Early Stuart spawners were much fewer than expected. Shortly after this, disappointing returns of spawners were also announced for the Early Summer stocks.

The high expectations for 1992 sockeye were not being realized.

Fears that later Summer and Late stocks would perform as badly were not borne out, however. Summer and Late runs appeared stronger than expected, but the shortfall in the Early runs caused much anxiety.

It was hard to explain such low returns to the spawning grounds when, using well-established counting methods, so many fish had been counted entering the river. Fishermen and fishing organizations protested and demanded explanations. Accusations of poaching, abuse of fishing agreements and incompetence by the Department were rife.

To clear the air, the Minister of Fisheries and Oceans appointed Dr. Peter Larkin and me to conduct a thorough investigation of the circumstances explaining the apparent discrepancy in the estimates of expected and actual spawners, and to recommend needed improvements in the management system. This report contains our findings.

PACIFIC SALMON represent one of the world's most complex problems of fisheries management; and nowhere is it more complicated than in the Fraser, the world's most productive salmon river. The Fraser supports all five species of Pacific salmon – chinook, coho, pink, chum and sockeye – each comprising several stocks that must be managed individually. Fishing is also complicated, involving commercial, sport and Indian fisheries, each of which consists of distinct groups and all of which share the catch. Finally, the institutional framework for managing these fisheries is an intricate web of federal and provincial law and policy, aboriginal rights, international treaties and consultative structures.

Every year from June to October a succession of salmon stocks, each destined for a particular spawning tributary, approaches the Fraser from the Pacific Ocean. They pass through areas of commercial and sport fishing in the straits of Georgia and Juan de Fuca, then enter the river where they are harvested in the Indian fishery, leaving the survivors to spawn and replenish the stock.

Management Planning and Fishing Regulations

The management challenge is to ensure enough fish of each stock of each species reach their spawning grounds in order to maintain the population. Beyond this, the task is to allocate the surplus among the competing groups of users. In Canada, these responsibilities are assigned to the federal Department of Fisheries and Oceans (the Department). However, some stocks of salmon that spawn in Canada pass through U.S. waters and are intercepted by U.S. fishermen and vice versa, so Canada and the U.S. created the Pacific Salmon Commission. The Commission has the responsibility for allocating catches of these stocks, including Fraser salmon, between the two countries. The Commission's Fraser Panel, with members from Canada and the U.S., makes recommendations about fishing within the treaty area (roughly the Strait of Juan de Fuca and southern part of the Strait of Georgia). Outside this area, fishing is managed by the Department and its U.S. counterpart.

Each year's fishery is planned well in advance. The Commission makes a rough pre-season forecast of the abundance of each stock based on its historical performance, recent trends, ocean conditions and, in some cases, the counts of young fish before they went to sea several years earlier. In sockeye populations, a proportion returns as three-year-old jacks; their abundance is another indicator of the number of four-year-olds expected the following year. Using these forecasts, objectives are set for catches and escapement (Table 1). Managers then prepare a fishing plan designed to meet these objectives, setting out how the fishery will be regulated with openings and closures for the various fishing groups.

As the fish move inshore and along the coast, more information is obtained about the incoming stocks. Their abundance is estimated by test fishing and their stock composition by analysis of their scales and other characteristics. The pre-season forecast is revised in light of the new information and so becomes more reliable. In many cases, this means the pre-season plan must be modified.

When fishing begins, it is closely and continuously regulated by the Department. Openings are declared to allow the harvestable surplus to be taken and shared appropriately, while ensuring sufficient numbers of fish "escape" to spawn. Usually, the troll fleet takes the first catches; the seine fleet is second; the gillnet fleet in the river mouth is third; Indian fisheries in the river itself are fourth. On the U.S. side, these same stocks are fished by seiners, gillnetters and an Indian fishery, which includes a trap at Lummi Island.

Juggling the openings and closures to meet the fishing plan's multiple objectives is exceedingly complicated. Success depends heavily on co-operation from fishermen to pro-

vide information and comply with regulations. Targets are rarely met precisely and compensating adjustments must be made. Shortfalls in escapement are taken into account in designing fishing plans for later years when the succeeding generations return.

In spite of the difficulties, the Commission and the Department managed to conserve and even expand major stocks of Fraser salmon. Since the 1960s, there has been healthy growth in returns of sockeye on the 1992 cycle year (see Figure F, page 32). This is a result of careful regulation, fishways constructed at difficult points of passage in the river, and enhancement works. Not all stocks have fared so well and while much remains to be done to achieve the full potential of the Fraser, in the dismal perspective of fisheries conservation elsewhere in Canada and throughout the world, the record of Fraser sockeye management is commendable.

Providing for Indian Fisheries

The Indian fishery on the Fraser River presents special problems for fishery managers. For many years the Department accorded the traditional Indian fishery priority over sport and commercial fisheries, a priority which has been strengthened considerably by court decisions during the last couple of years. Today, the law states that Indians have an aboriginal right to fish, protected by the Constitution. This right can be restricted only when it is necessary to conserve the stock. For fisheries managers, this ranking of priorities – spawning escapement, Indian fisheries, sport and commercial fisheries – presents difficulties since migrating stocks are encountered in the reverse order. Managing catches and shares of catches is a difficult business at best. When, in addition, the total stock size is only roughly known, allowances made for spawning and Indian catches are often not attained.

To further complicate matters, the catches that must be provided to Indians along the river have never been quantified. The Department has depended upon restrictions on fishing time, fishing gear, and fishing places to constrain catches and to ensure escapement.

SOCKEYE:

One of the five species of Pacific salmon, sockeye yield high returns to commercial fishermen – some \$250 million annually, half the total value of B.C.'s commercial salmon fishery. This is also the most important species to native Indians.

Accordingly, when the Department and the Commission design pre-season fishing plans and regulate fishing during the season, they make a forecast for the Indian fishery and seek to ensure enough fish enter the river to accommodate this fishery plus the number of spawners wanted. Based mainly on historical data the plan forecast a 1992 catch of 615,000 sockeye from various stocks (see Table 1).

Unusual Circumstances in 1992

In 1992, management of Fraser salmon was further complicated by special circumstances and events. As noted below, three of these have an important bearing on this investigation.

Weather Disturbances

The North Pacific was experiencing El Nino's warm water current which causes salmon to circle farther north on their return to the coast. It was expected that a large proportion of these fish would approach the Fraser through Johnstone Strait rather than the Strait of Juan de Fuca. This meant that U.S. fishermen in Puget Sound might have access to fewer Fraser fish. As well, sockeye were expected to arrive later than usual.

In addition, a hot, dry summer threatened to diminish water flows in the river and its tributaries and to raise water temperatures, both of which cause stress to migrating salmon.

Breakdown in International Co-ordination

For the first time in its history the Commission failed to reach agreement on the division of catches of Fraser salmon between Canada and the U.S. Representatives of the two countries could not agree on the U.S. entitlement. The Commission provided information to the two agencies as usual, but fishing did not

proceed under a single, coherent plan. Canada and the U.S. designed fishing plans independent of each other, threatening to cause competitive fishing on the same stocks. At one stage of the season both countries' fleets were fishing continuously.

In the end, the U.S. fleet took many more sockeye than Canada thought it was entitled to. Fishermen in Alaska took unusually large catches when stocks circled northward. U.S. fishermen had another unusual opportunity when a combination of winds and tides pushed the stocks approaching the Fraser into U.S. waters off Point Roberts.

Table 1: Pre-Season Forecast for Fraser River Sockeye in 1992 (thousands of fish)

	returns ¹	commercial catch at sea	escapement past Mission	Indian fishery catch	spawners
Early Stuart	700	300	400	200	200
Early Summer	1,421	} 2,350	} 1,386	} 385 ²	351
Summer	2,315				650
Late	1,394	1,007	387	30 ²	357
Total	5,830	3,657	2,173	615	1,558

¹ Excludes 70,000 jacks.

² Estimated during the fishing season.

New Indian Fisheries

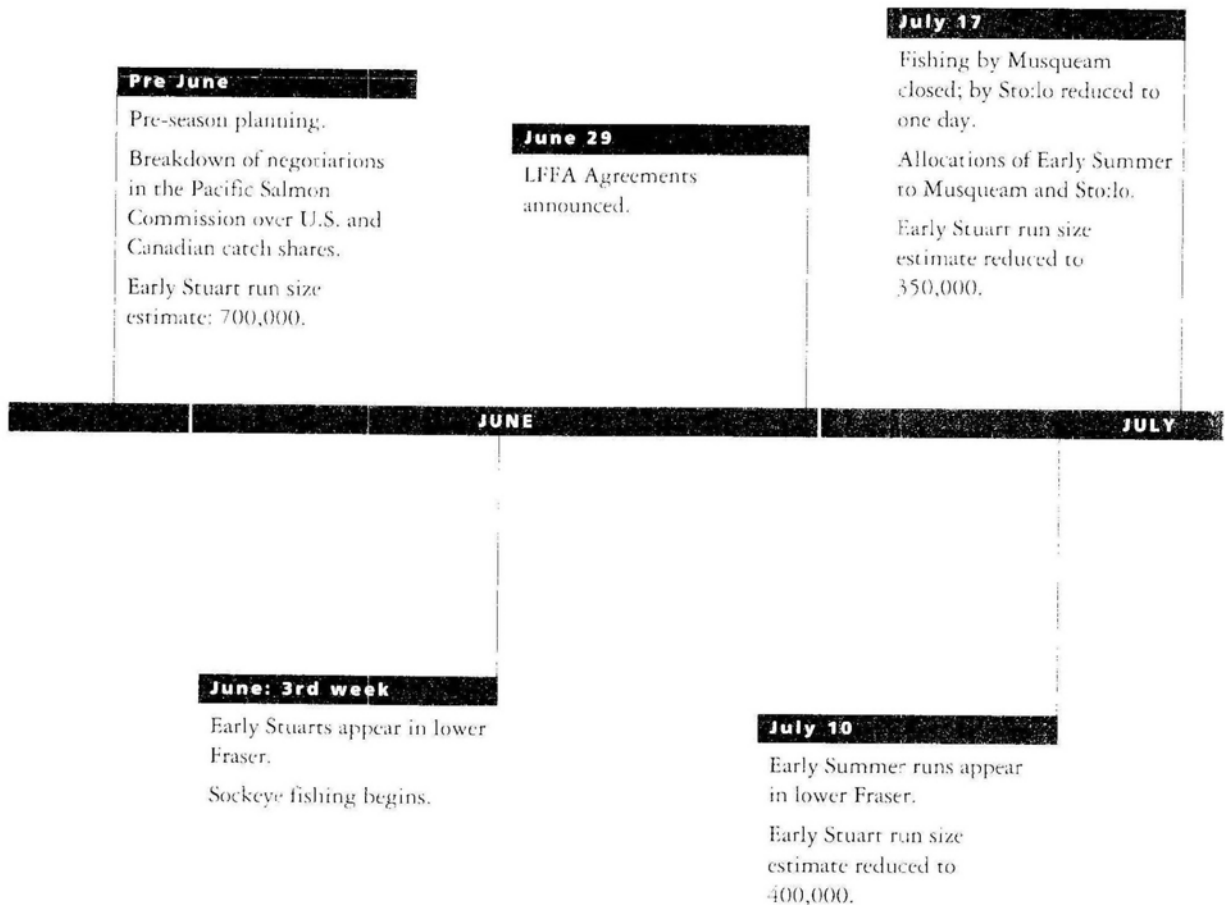
Just as the sockeye season was beginning on the Fraser, the Department concluded unprecedented agreements with Indian communities along the lower reaches of the river. The agreements were pilot projects in joint management, giving participating Indian communities responsibility to license their fishermen and monitor catches. Two provisions represented breakthroughs in the history of the Indian fisheries: Indian communities accepted and were allocated a specific

number of fish; they were permitted to sell their catch. These arrangements created an entirely new environment for the Indian fishery and for the Department's managers.

1992 Fishing Season

The earliest forecast of Fraser sockeye returns in 1992 was seven million fish - the largest number in decades. In January, with new information about the incoming stocks, the estimate was reduced to 5.83 million, the pre-season forecast.

Fishing for sockeye in the Indian fishery began in the week of June 22 when the Early Stuart run entered the lower Fraser, five or six days late. Openings and other regulations conformed with pre-season plans and the forecast returns of 700,000 fish. The objective was to allow 400,000 fish to enter the river, of which the Indian fishery would take 200,000, leaving an equal number to spawn.



Of the expected catch in the Indian fishery, 75,000 were expected to be taken in the upper river – above Sawmill Creek which is an important dividing line in the Fraser canyon just upstream from Yale. The remainder was allocated to Indian communities on the lower Fraser – the Musqueam and Tsawwassen bands on the estuary, and the Sto:lo in the area from Fort Langley to Sawmill Creek.

Estimates of the size of stocks while still at sea are always uncertain since only flimsy information about them is available. As the Early Stuarts entered the straits, it became clear the stock was smaller than predicted. By July 17 the estimate had been halved to 350,000 fish, leaving no surplus for the commercial sector.

The U.S. gillnet fishery had taken only an insignificant catch, and the Canadian fishery in southern waters remained closed to let the rest of the Early Stuart run enter the river.

Because of the reduced run size, the allocation to Indians on the lower river was reduced to 150,000. By mid-July the Musqueam had taken their allocation of Early Stuarts, so their fishery was closed. The Sto:lo were given a one-day opening to fill their remaining quota. Soon after this, the estimated size of the Early Stuart run was reduced further to 325,000 and all Indian and commercial fishing was closed. The echo-sounder at Mission estimated that 286,000 Early Stuart sockeye had passed upstream.

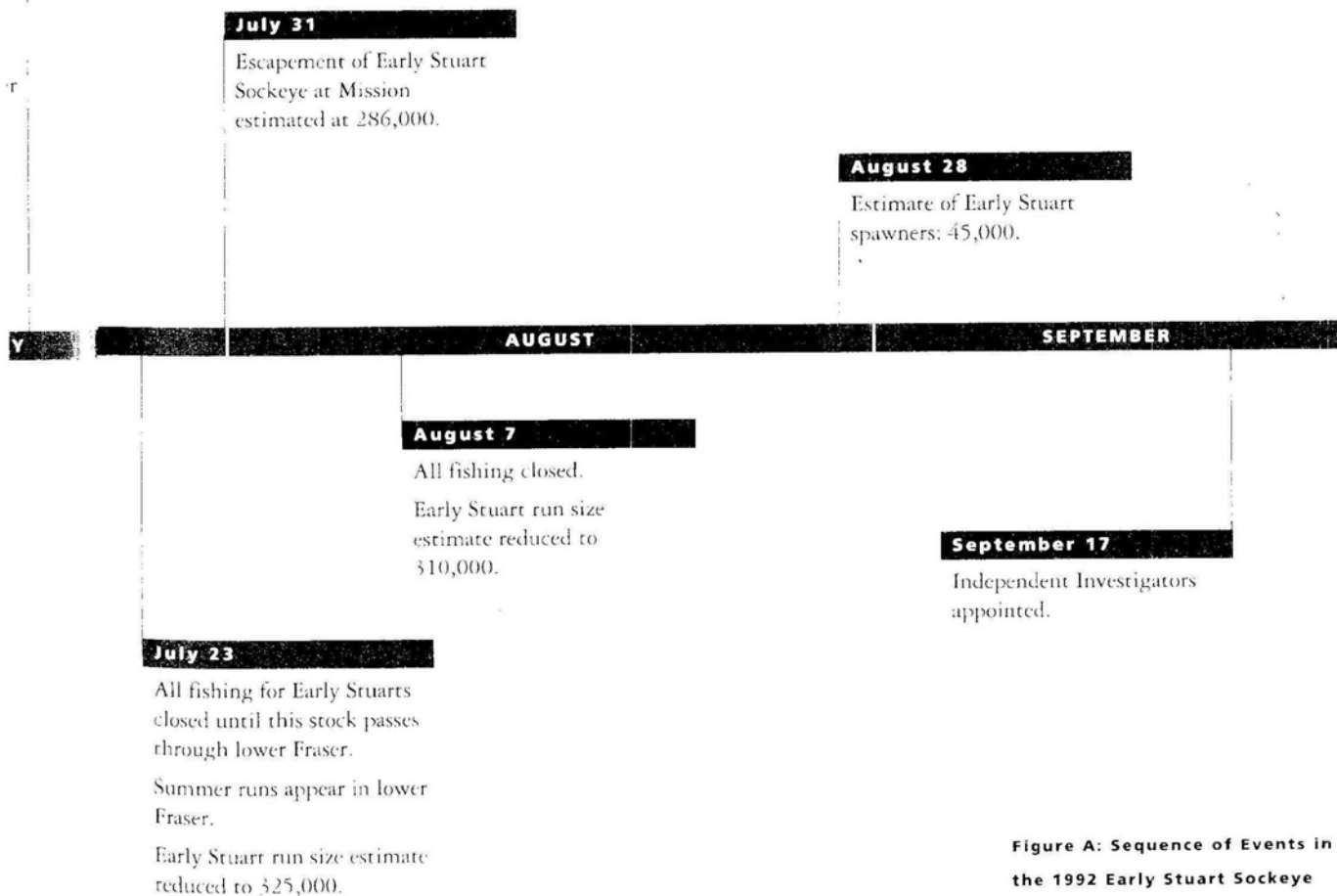


Figure A: Sequence of Events in the 1992 Early Stuart Sockeye Fishery on the Fraser River

During the fourth week of July, managers' attention shifted to the Early Summer run. This run was also about a week late but had a pre-season forecast of 1.4 million fish. Both the Summer and Late stocks promised a significant surplus for the commercial sector.

At the beginning of August commercial fishing began in both Canada and the U.S. The following two weeks were marked by heavy commercial fishing in both countries, fishing under the new Indian fishing agreements in the lower river and traditional Indian "food fishing" upstream. By the third week in August Early Stuarts were far upstream and most of Early Summer and Summer groups were in the river, all five to 10 days late.

Early reports from the spawning grounds indicated smaller numbers than expected, raising concerns about meeting escapement targets. On August 11 the preliminary estimate of Early Stuart sockeye reaching the spawning grounds was announced as being only 45,000 of the anticipated 200,000. Within a week all fishing on the lower river was closed, even though the recorded catch was short of the original allocation.

Alarming reports about the numbers of spawners continued into September. Based on numbers counted at Mission and reported numbers caught in the river, many of the Early Summer stocks had less than half the expected spawners. Only the later part of the runs of Early Summer stocks and Late stocks could be accounted for in the estimates of catches and spawners after they entered the river.

In the end, the goal for the number of spawners was achieved only for the Late group. The Canadian commercial fleet had caught

3,387,000 and the U.S. fleet 698,000. This exceeded the pre-season forecast for the commercial catch by 428,000. The Indian fishery, according to catch estimates, had taken less, and considerably less than in the two preceding years. This was partly because this was the cycle year of lowest abundance, and partly because of the early closure of the season.

The Indian fishery also took 12,000 chinook, about the average for the previous five years, and smaller than usual catches of coho and chum. Estimated catches of steelhead were unusually low, as a result of the Indian fishery closure from August to October when migration of this species is at its peak.

The results of the 1992 sockeye season for the Early Stuart, Early Summer and Summer stocks as estimated by the Department and the Commission are summarized in Table 2. It must be noted these figures in Table 2 were the latest estimates available when this report was written. As a result of additional field information and revised calculations, they differ in some cases from the estimates available when this investigation started.

The right-hand column in Table 2 depicts the central problem – the fish that entered the river but cannot be accounted for. These "missing sockeye" are the subject of subsequent chapters.

Table 2: Post-Season Official Estimates of Catches and Escapement of Fraser River Sockeye in 1992 (thousand of fish)

	returns	commercial catch at sea	escapement past Mission	Indian fishery catch ¹	unaccounted for spawners
Early Stuart	310	0	301	120	65
Early Summer	1,020	376 ²	361 ³	102	100
Summer ²	4,070	3,351	991	160	624
Total ⁴	5,400	3,527	1,653	382	789

¹ Excludes Upper Pitt stock.

² Includes Chilko Lake stock.

³ Excludes catch below Mission. For total Indian fishery catch see Table 4.

⁴ Excludes Late stocks.

THE INDIAN FISHERY has a special place in Canada. It is quite distinct from the commercial and sport fisheries in its historical origins, legal foundation, manner and location of fishing. The Indian fishery is rooted in the ancient dependence of aboriginal people on fish and their traditional practice of fishing for food and other purposes. Salmon are particularly important to this fishery, especially on the Fraser River.

The Indian fishery was the focus of much controversy in 1992. Among other things it was governed, in part, by agreements the federal government had entered into with certain Indian communities on the lower reaches of the river just as the sockeye season began. I made a special effort to investigate the conduct of this fishery last summer.

RETURNS:

The number of fish returning from the sea to their natal spawning streams. This is the total stock before fishing.

ESCAPEMENT:

The number of fish that "escape" fishing and reach their spawning streams.

At the onset I encountered a great deal of misunderstanding about the Indian fishery and the reasons for the new Indian fishery Agreements. Misunderstandings fouled relations with competing commercial and sport fishing groups and are impediments to progress in fisheries management. While I cannot attempt a comprehensive review here, it is important to sketch the context of the new Agreements and the problems encountered in implementing them last summer.

Aboriginal Fishing Rights

Under Canadian law, aboriginal people who have historically used resources such as wildlife and fish have the right to continue to do so. Prior to European settlement, Indians throughout the Fraser basin depended heavily upon salmon. Most of their villages were located where fish could be taken with traditional technology – such as dip-nets, gaffs, gillnets and traps. Salmon, cured in traditional fashion, was their staple food. The routine of life was geared to the annual salmon runs. Elaborate arrangements governed tenure over fishing places among clans and families. Fish were currency in trade.

With white settlement and development of the fish-canning industry in the last century, the federal government took steps to regulate Indian fisheries. Around the end of the last century Indian fishermen were required to obtain licences, confine their fishing to prescribed times and places, use only certain types of gear, and refrain from sale or trade in the fish they caught.

Since the early 1970s, as a matter of policy, the Department has ascribed priority to the Indian fisheries over commercial and sport demands. The Department interpreted its primary responsibility (as spelled out in the Fisheries Act) as ensuring enough fish are left to spawn to sustain the stocks. Any surplus would be allocated first to the Indian fishery; any surplus beyond that to the commercial and sport sectors. In practice, this order of priorities was and is difficult to achieve as Indian fishermen have access to stocks only after commercial and sport fishermen.

Over the years, catches in the traditional Indian fishery declined as the Indians themselves were devastated by European diseases. As populations revived in recent decades however, their catches have grown also. See Figure C.

Today there are about 90,000 status and 65,000 non-status Indians in B.C., of which some 25,000 are associated with 93 bands along the Fraser. But Indians on the Fraser are not the only ones that depend on this river's salmon. Bands along the coast also catch fish bound for the Fraser, as do commercial and sport fishermen.

In total, the Indian fishery accounts for about 3.4 per cent of the total catch of salmon in B.C. and 9.4 per cent of the sockeye.

Some Indian leaders and many Indian fishermen have

never accepted restrictions on their fishing and argue their aboriginal rights entitle them to take fish however they wish, and to use them as goods in trade. This has been a strongly-held position among Indians in the Lower Fraser Valley where Indian fishermen and their leaders vigorously rejected the Department's regulations.

Salmon sold by Indians was a familiar sight in the Lower Mainland.

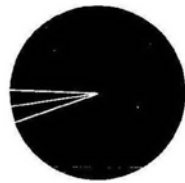
The enforcement problem was exceedingly difficult. Regulating fishing was hard enough, but the no-sale rule

meant fishery officers and police often had to trace the fish to the final consumer. Not surprisingly, compliance and enforcement were weak. While the prevalence of "illegal" sales cannot be determined (although estimates run as high as 90 per cent in some areas) it is safe to say that most of the salmon caught in the Indian fishery along the lower Fraser in recent years were sold.

Court decisions tended to weaken the regulatory powers of enforcement officers. Through seemingly endless litigation and court judgments, the rights of Indians were strengthened. In 1990, in the landmark Sparrow case (which involved a Musqueam Indian charged with using a net longer than permitted) the Supreme Court of Canada clarified the law significantly: Indians have an aboriginal right to fish, at least for food, social and ceremonial purposes, whether they signed treaties or not. The traditional restrictions on gear, fishing time and so on can not be applied to Indian fisheries unless the fishing threatens the stocks or other aboriginal peoples' access to fish.

The court said nothing about the right to sell fish, but ruled that the government had a duty to consult with Indians to determine how these aboriginal fishing rights could be satisfied while meeting conservation objectives.

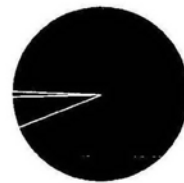
Figure 8: Shares of the Salmon Catch Among Major Users



All species of salmon

- Commercial Fishery 93.2%
- Sport Fishery 3.4%
- Indian Fishery 3.4%

Average over the past five years.



Sockeye only

- Commercial Fishery 90.0%
- Sport Fishery 0.6%
- Indian Fishery 9.4%

Average over the past five years.

More recently, courts have supported the right of Indians to sell at least small amounts of fish consistent with amounts involved in traditional use. While these decisions have been appealed, they strengthened the determination of some Indian groups to assert their rights, if necessary by direct confrontation.

Governmental Responses

As the changing law narrowed the scope for regulating Indian fisheries, the Department switched its enforcement efforts to large-scale sales of fish and flagrant abuses of Indian fishing rights. Because of the legal uncertainty the Department adopted a cumbersome policy of referring cases to the Department of Justice for guidance before laying charges.

The Sparrow decision forced the government to respond to a partly-defined and evolving

aboriginal right to fish, protected by the Constitution, without prejudicing the ultimate resolution of the issue through comprehensive claims settlements. A means of achieving effective regulation in this new legal environment was sought in negotiated agreements with native communities. These would meet the requirement to consult and allow agreed-upon regulations to be enforced.

In 1991, the government launched its Aboriginal Fisheries Co-operative Management Program which enabled native groups to become involved in fisheries management, enhancement and habitat improvement activities. Some 150 agreements, costing \$11 million, were entered into with Indian communities across Canada. This program was considered successful in providing experience for both

government and Indians in co-operative management and evidence of native capabilities in these activities.

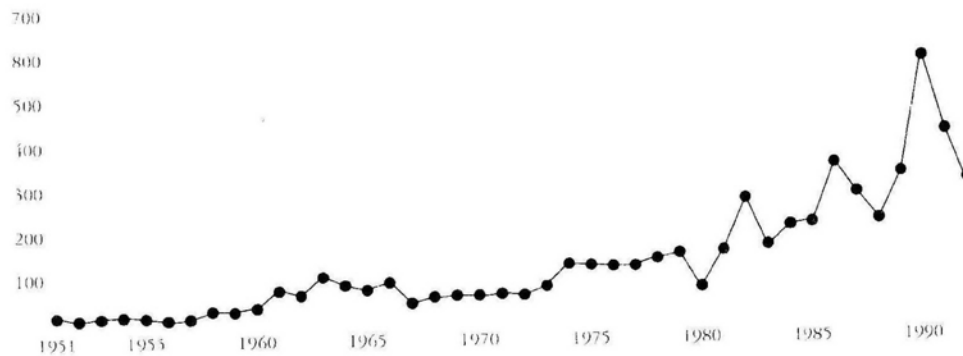
On another front, the B.C. Claims Task Force proposed a blueprint for addressing Indian claims in this province. In 1991 this proposal was endorsed by both provincial and federal governments. The Task Force recommended "interim measures agreements" to provide for aboriginal fishing, pending full settlement of native claims.

The Aboriginal Fisheries Strategy

On June 29, 1992 the Minister of Fisheries and Oceans announced an Aboriginal Fisheries Strategy. The general objective of this five-year program is to fulfill the government's newly-defined obligation to consult with native people about how best to provide for their rights to fish

Figure C: Catches of Sockeye in the Indian Fishery of the Lower Fraser River (*thousands of fish*)

Below Sawmill Creek (includes small catch at North Bend).



and to end the conflict and litigation by engaging native people in managing fish resources and by providing them new economic opportunities in fishing. The program includes:

- Formal interim agreements with Indian groups in which they are assigned responsibilities for fisheries management, including regulating Indian fishing, surveillance, catch monitoring and enhancement projects. Federal funding is provided for these activities and for training. Last summer, some 80 agreements were signed with Indian groups in B.C.
- Special agreements in 1992 with Indian communities on the Skeena, the lower Fraser and at Port Alberni, which for the first time provided

specific allocations of salmon for the Indian fishery and one-year pilot projects for the sale of fish.

- A \$7-million fund to be used to buy out commercial fishing licences in order to minimize dislocation in the commercial sector as the Strategy is implemented.
- A B.C. Fisheries Commission, made up of representatives from commercial and sports fishing interests, to advise the Minister in implementing the Aboriginal Fisheries Strategy and the buy-out of commercial licences. This advisory group was allocated \$100,000 with a commitment for another \$500,000.

The main instruments for applying the new Strategy are the Agreements with Indian groups.

Indian Fishery Agreements on the Fraser

In the wake of the Sparrow decision and the report of the B.C. Claims Task Force, the "Summit Group" of native leaders pressed the Department to take steps toward interim measures regarding the fisheries. They also insisted on negotiating directly with Ottawa, expressing a lack of confidence in the willingness of regional staff to contemplate fundamental change.

The Deputy Minister of Fisheries and Oceans held discussions with tribal councils and bands throughout B.C. with a view toward negotiating fishing agreements. The discussions were faltering and frustrating on both sides. An attempt by native leaders to bring together all Indian communities in the province in a fisheries framework agreement with the federal government failed earlier this year. So did a proposal for a co-ordinated fishing plan for the Indian groups on the Fraser. But progress was made with certain groups and federal officials resorted to negotiations with them individually. By the end of June, one-year agreements in principle had been entered into with eight First Nations in B.C.

The Agreements between the Department and the Sto:lo, Musqueam and Tsawwassen Indian communities spelled out a co-operative management project under

SPARROW DECISION:

In 1990, the Supreme Court of Canada ruled, in a landmark decision, that natives have an aboriginal right as defined in the Constitution to fish for social and ceremonial needs, and that this right takes priority over all other demands except conservation.

the umbrella of the newly-created Lower Fraser Fishing Authority (LFFA). The Agreements provided the Indian communities with specific allocations of sockeye, chinook and chum salmon for food, social and ceremonial purposes and for sale. While the allocations did not exceed the quantities of fish caught by these communities in recent years, the provision for sale of the fish was considered a major breakthrough by Indian groups who felt that they had hitherto been denied their aboriginal rights to trade in fish. Six bands in the lower Fraser did not join in the Agreements.

The Agreements also provided that the Indians would assume a range of management responsibilities, including the licensing of fishermen, catch monitoring, and surveillance of fishing. The LFFA was provided \$1.1 million to finance native guardian programs, catch monitors and other management costs.

Finally, the Agreements provided for a Joint Technical Committee to deal with technical problems in managing fishing. This was established with members representing Indian participants and the Department.

The 1992 Indian Fishery:

A Troubled Beginning

Early Stuart sockeye were already running up the river when the Agreements were announced in late June. The management system had to be quickly organized and adapted to the Agreements since fishing had already begun.

The 1992 fishing season got off to a bad start. The preceding year had been marked by rising tensions between native groups and the Department. On the lower Fraser, the mild winter meant fishing for chinook salmon had begun early ... but there was trouble over licences. Some Indians refused to obtain fishing licences from the Department in 1991. The standoff continued. There were also many violations of rules about closures, net sizes, net markings and illegal gear.

The Sparrow decision specified that Indian fisheries could be regulated only under stringent conditions. To ensure these complicated criteria were met, in June, 1991 the Department issued new national guidelines for enforcement, forbidding fishery officers from laying charges until they obtained authorization in advance from both their headquarters and the Department of Justice. This requirement was cumbersome and frustrating. Approvals were inconsistent and sometimes no response was forthcoming before the court appearance.

Enforcement was therefore weak and fishery officers felt powerless, frustrated by an apparent lack of support from their superiors. They also say they were harassed by some native leaders.

On the lower river where relations with Indians were already strained, the 1992 season began with no licensing and no management plan in place. Legal authority was therefore lacking and policy direction was unclear. By May, fishing activity was increasing as the numbers of chinook in the river increased; this activity was largely out of control. An interim fishing agreement for chinook fishing was belatedly entered into with the Sto:lo Nation and Tribal Council but its basis in law was unclear and fishery officers, uneasy about their legal authority, were reluctant to enforce the agreement's regulations.

Meanwhile, senior officials were accelerating negotiations toward agreements with the Sto:lo, Musqueam and Tsawwassen people before the sockeye season began. This created further enforcement problems on the river. Local officials were directed not to try to negotiate fishing plans or issue licences and not to lay any charges while the sensitive negotiations were continuing. They were instructed, instead, to merely observe, record and report offences. Except for the most flagrant offences, enforcement became impossible and non-compliance was the order of the day.

Thus, the circumstances in which the experimental Agreements were launched were not auspicious.

First, they dealt with the lower Fraser – which has been the most problematic region in western Canada for the Department to administer in recent years. It was here that the prohibition of sales had been openly challenged and litigation had questioned both the law and the Department's authority to regulate. Here too, Indian fishing was on a larger scale, more conspicuous, and more visibly competitive with other fishing interests than anywhere else. Channels for the illicit sale of fish and an infrastructure for handling them were well established. Fishermen had become cynical about the Department's regulatory efforts.

Second, enforcement had broken down. Court rulings and policy decisions had undermined fishery officers' abilities to effectively enforce regulations. It soon became common knowledge that these officers had been instructed not to lay charges.

Third, the Agreements covered only some Indian communities on the river. This gave rise to accusations of preferential treatment. For the Department, it meant different management regimes on different parts of the river and enforcement problems arising from the legality of sales in some areas but not others.

Finally, the new arrangements were launched at the eleventh hour – after the summer fishing season had begun. The lack of advance preparation gave rise to many problems. The LFFA and band offices suddenly had the difficult task of administering fishing licences, which meant identifying eligible band members, issuing identification cards and net-mark numbers to fishermen and so on.

Monitors and guardians had to be recruited and trained. Provincial authorities had to license fish buyers, which normally involves detailed inspections to ensure health and equipment standards are met. Local fishery officers had to train native guardians, develop new surveillance and catch-monitoring arrangements and establish new working arrangements. They received no supplementary resources to carry out this extra work. In fact, personnel and budgets had been chopped.

In retrospect, the arrangements put in place at the beginning of the 1992 sockeye season invited trouble. A large number of experienced fishermen and people who dealt in fish, many of whom did not consider it wrong to disregard the Department's rules, were presented with a new fishing opportunity. The situation called for close regulation and control, but the Department had lost most of its regulatory power. The arrangement had been put together hastily leaving Indian communities ill-prepared. Other Indians felt left out, feeling they had an equal right to catch and sell fish.

Problems Encountered

Much went wrong. The degree of success varied considerably, however. In the Musqueam and Tsawwassen area, things went surprisingly smoothly. Up the river, in the Sto:lo area from Langley to Sawmill Creek and farther upstream in the Fraser canyon where no Agreements were in place, the picture was quite different. Reports and other evidence I received of fishing from Mission to Lillooet tell the story of unprecedented intensity, management confusion, weak surveillance and enforcement, and general excess. Highlights include:

Fishing Effort Increased Sharply

The LFFA came under heavy pressure to issue fishing permits (or "designation cards"). Permits were issued to anyone over 18 years of age who the LFFA had reason to believe was entitled to fish in the Indian fishery, including anyone who held a Department licence from a previous year, appeared on a band list, or held a letter from a chief or council attesting eligibility.

The number of eligible band members had already increased as a result of recent federal legislation reinstating the status of Indian women

who married non-Indians. In some bands, this expanded the band lists considerably. Altogether, some 1,200 permits were issued.

Each permit entitled the holder to fish one net. The right was transferable however, and some fishermen purchased or otherwise acquired the rights of others so they could fish several nets. The peak count of nets in the lower river doubled from 434 in 1991 to 885 in 1992.

The traditional system of tenure over fishing places was strained. Families in river communities hold rights to the limited number of preferred fishing spots through an hereditary system carried over from ancient times. Native fishermen usually respect the

authority of the owners. But in 1992 the owners were pressured by newcomers. In turn, elders complained their fishing sites were being pre-empted by outsiders. One band, not party to the Agreements, unsuccessfully sought a court injunction to exclude others from fishing in its area. Problems of crowding, intimidation and even violence ensued. There were also many reports of stolen fish and fishing gear.

Fishing activity along the river was far more conspicuous than in previous years. Camps, from which fishermen could attend to their nets at night, sprung up on the riverbank near important fishing sites upstream from Mission — these camps were a rare sight previously. Fishermen's vehicles along the river indicated that more than usual came from elsewhere, including the U.S. There was much traffic in truckloads of fish. There were disturbances, notably around Yale which became the biggest landing site on the river and the sales centre for fish caught upstream and downstream. Local officials complained about traffic noise, refrigerated trucks parked along the highway, the smell of fish, litter and the lack of sanitation facilities for scores of campers along the riverfront.

LFFA (LOWER FRASER FISHING AUTHORITY):

In 1992 the Department of Fisheries and Oceans entered into Agreements with the Sto:lo, Musqueam and Tsawwassen peoples on the Lower Fraser which authorized the commercial sale of fish caught in the Indian fishery.

Intensive fishing extended beyond the Agreement area up the Fraser canyon. There were reports of fish being trucked down to where sales were permitted and to other places. Expert fish buyers, who can tell from the condition of fish how far up the river the fish were caught, also reported upstream fish being offered for sale.

Relations Between the Department and Indians were Strained

The Agreements strained relations between Indian communities on the river and Department officials:

- Bands up-river felt the Agreements gave lower-river bands preferred treatment.

Federal funding for co-operative management programs with Indian communities was reallocated in favor of communities that entered into Agreements. Other bands found their expected funding cut, undermining working relationships between them and the Department's field officers and other Indian communities.

- The six bands that declined to enter into the Agreements pressed the Department for their customary fishing plan and licences, but the Department held off. As a result the independent bands remained largely unregulated through the salmon season; at least one band staged a protest fishery.

Surveillance and Enforcement Broke Down

Enforcement was weakened by recent court decisions that circumscribed the authority of the Department to regulate Indian fishermen. Enforcement arrangements under the new Agreement were also unclear:

- Fishery officers had been instructed not to lay charges while delicate negotiations about fishing Agreements were ongoing.

- Requests by field officers for policy direction went unanswered. As violations became conspicuous in certain areas, local fishery officers were flooded with complaints and accusations of having failed to do their job. As their hands were tied, this criticism took a heavy toll on morale and pride.

- Enforcement arrangements under the new Agreements were unclear until the local fisheries officers took the initiative and negotiated with the IFFA a protocol on enforcement, to supplement the Agreement, but that was not until much of the season was passed.

- Up-river, beyond the Agreement area, surveillance and enforcement effort was abandoned altogether. Faced with cuts in staff and instructions not to lay charges, the Department's field staff threw up their hands.

Major enforcement problems developed. Formerly rare illegal practices such as drift gill-net fishing were observed. Up to 75 per cent of the nets inspected were not properly marked.

There was one notable exception: compliance with closures was high on the lower river, apparently attributable to support from Indian communities.

Fisheries Management and Administration Deteriorated

The Agreements put heavy additional demands on the Department's field personnel who were instructed to give these arrangements their highest priority. However, personnel and resources were not adequate.

- Field officers were expected to train Indian guardians and conduct joint patrols, even though in some areas needed equipment was not available until fishing had ended.
- Frustrating problems arose in trying to co-ordinate the fishing times for independent bands with the schedules for those governed by Agreements. There were also difficulties in co-ordinating commercial fishing times determined by the Fraser River Panel with the LFFA's decisions about Indian fishing in the river.
- The increased demands of the Agreements in the face of limited resources forced the Department's field staff to divert effort from other responsibilities in commercial and sport fisheries and habitat management.

Estimates of Catches were Unreliable

Under intense fishing, the method of estimating catches in the lower river broke down. The established technique for estimating catches, developed by fishery officers over many years, involves assumptions about fishing practices which

changed in 1992. The catch-monitoring system administered by the LFFA was also inadequate. Sales slips, which were supposed to be issued by all fish buyers, were inconsistently issued and so were unreliable measures of catches. Upstream, where the Department had abandoned surveillance, there were no estimates of catches at all.

As a result, the Department lost confidence in its catch estimates, which were nevertheless critical to the administration of the Agreements (and to this investigation).

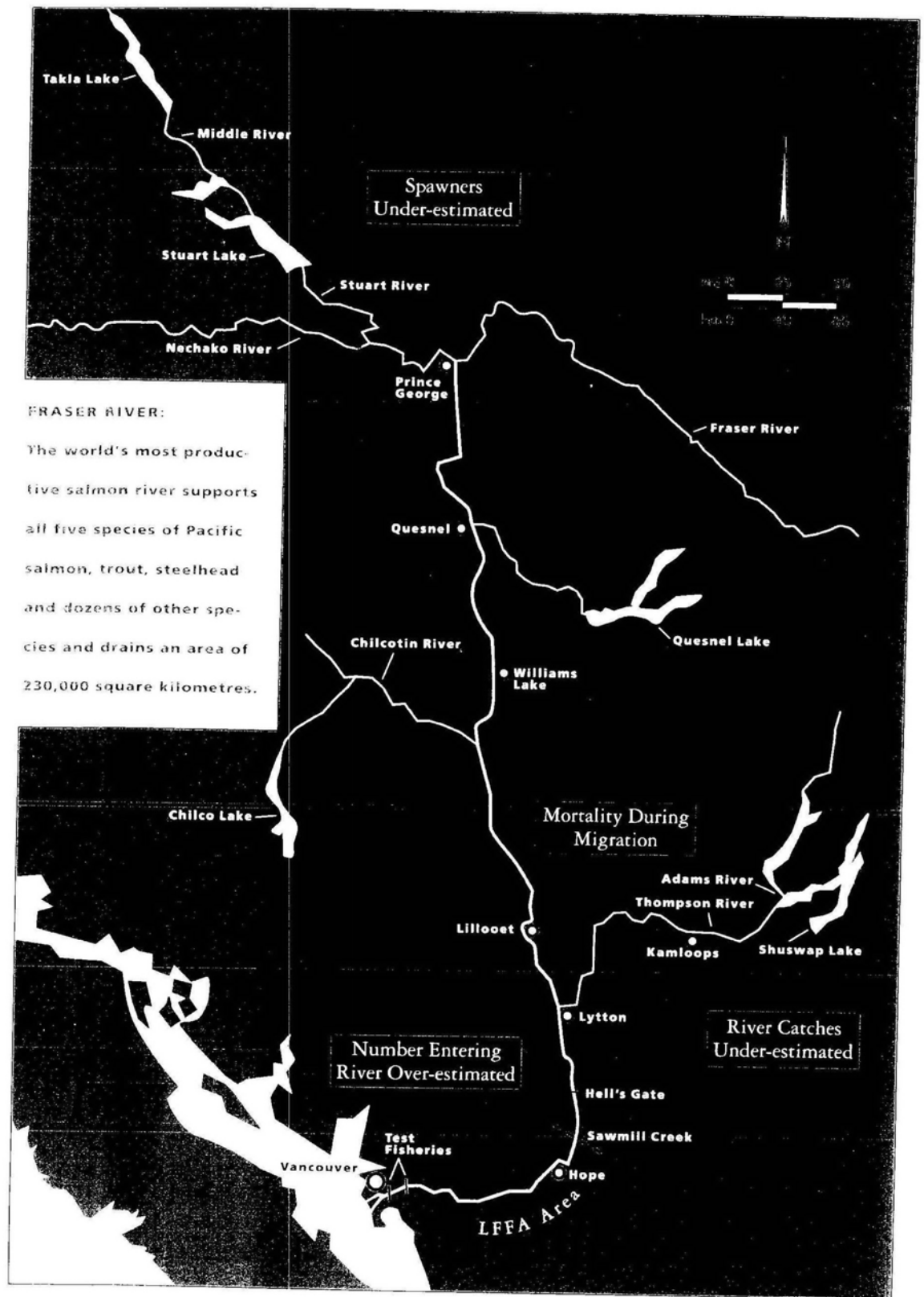
The new Indian fishery arrangements had the appearance of being hastily negotiated and implemented and threatened inconsistent treatment of Indian groups. As the fishing season advanced, a widespread perception developed that the fisheries on the Fraser River were out of control. The media reported alarming activity on the river, commercial and sport fishing groups expressed disapproval, the public began to lose confidence and the Department's competence was questioned. With the first reports of the shortfall in spawners, the Department and the new fishing Agreements became targets of criticism.

Table 3: Allocations and the Department's Estimates of Catches of Salmon for the Lower Fraser Fishing Authority (thousands of fish)

	Musqueam and Tsawwassen		Sro'lo		Total LFFA	
	allocation	catch	allocation	catch	allocation	catch
Sockeye						
Early Stuart	20.00	15.00	105.00	72.00	125.00	87.00
Other runs	50.00	49.00	220.00	172.00	270.00	222.00
Sub-total	70.00	64.00	325.00	244.00	395.00	309.00
Chinook¹	0.25	1.70	1.00	10.70	1.25	12.40
Coho¹	1.50	1.00	5.00	1.40	6.50	2.40
Chum¹	2.00	6.40	10.00	3.20	12.00	9.50
Total	73.75	73.10	341.00	259.30	414.75	333.30

¹ Allocations are the numbers provided for in the Agreement, excluding incidental catches while fishing for other species. Catches include incidental catches and catches before the Agreement came into force at the end of June 2, 1992 which explains why catches of chum exceed allocations to Musqueam and Tsawwassen, and catches of chinook exceed allocations to both groups.

THE MISSING SOCKEYE: POSSIBILITIES AND PROBABILITIES



BASED ON ALL THE information we received, we estimate that in the summer of 1992 there was a shortfall of 482,000 sockeye which should have reached their spawning grounds in the Fraser River system. We now address the explanation for this shortfall – the central question in my terms of reference.

The Shortfall in Spawners:

Latest Estimates

Since this investigation began in mid-September, the estimates of sockeye stocks, catches and spawners have all been revised. Some statistics may be further revised in coming months. When Dr. Larkin and I were appointed, the concern focused on a shortfall in spawners of the Early Stuart and Early Summer runs only. Preliminary counts on the spawning beds indicated that 105,000 Early Stuarts and 211,000 Early Summer were missing – 316,000 altogether.

More information has since been gathered from the spawning grounds, catch estimates have been reviewed and the escapement past Mission has been rechecked. Information about the Summer and Late stocks has also become available. At time of writing, the best estimates of the Department and the Commission show that 116,000 Early Stuarts, 159,000 Early Summers and 207,000 Summers are unaccounted for – a total of 482,000 missing spawners (Table 2).

Late stocks are omitted as many spawn in the lower tributaries of the Fraser and entered the river after fishing was closed: their numbers are fully accounted for.

Possible Explanations

To explain the shortfall in spawning salmon, Dr. Larkin and I first identified all the reasonably possible causes. There was no shortage of suggestions from fisheries managers, scientists, enforcement officers, fish buyers, representatives of fishing organizations, native groups and others, including people who were not involved in fishing but had some knowledge of events on the river last summer. Of all the suggestions, there were four that warranted investigation:

- The number entering the river was over-estimated.
- The number reaching the spawning beds was under-estimated.
- The mortality due to natural or environmental stress in the river was under-estimated.
- The numbers caught in the river exceeded estimates.

With the help of scientists and others in the Department and the Commission, we investigated each possible explanation. Teams of experts reviewed, cross-checked and analyzed a very large volume of data and information to help us narrow the range of possibilities.

Dr. Larkin distilled their detailed studies and reports in the Appendix, and supplemented them with his professional judgment to explain the remaining discrepancies. Here, I summarize the findings.

Over-estimate of Numbers**Entering the River**

The estimates of the number of salmon entering the river (Table 2) are based on acoustic counting at Mission. There, the Commission operates a hydro-acoustic echo-sounder mounted on a small boat which traverses the river and records the number of fish passing under it, following a carefully-designed sampling pattern. The results are subjected to a variety of corrections and adjustments (to allow for such things as resident fish passing to and fro) to yield estimates of the total number of salmon passing up the river.

Different species of salmon and different stocks of sockeye mingle as they migrate up the river. Since fisheries managers need information about the escapement of each stock, the acoustic-counting program is supplemented with a means of identifying

the fish according to the various stocks. This involves catching samples of the passing schools of fish and identifying the proportions of each stock through their distinctive patterns of scale growth.

These combined programs provide estimates of the numbers of each stock, or group of stocks, passing up the river at any one time. This system has been used for 15 years.

Both the method of counting the fish passing Mission and the method of allocating them to various species and stocks have been rigorously analyzed for the purposes of this investigation. Our conclusions are threefold.

First, there were no significant mistakes, misallocations of stocks or unusual sources of bias in the data or analysis in 1992.

Second, the estimates are subject to error (as all sampling estimates are) but it is unlikely that the error would exceed 10 per cent in total.

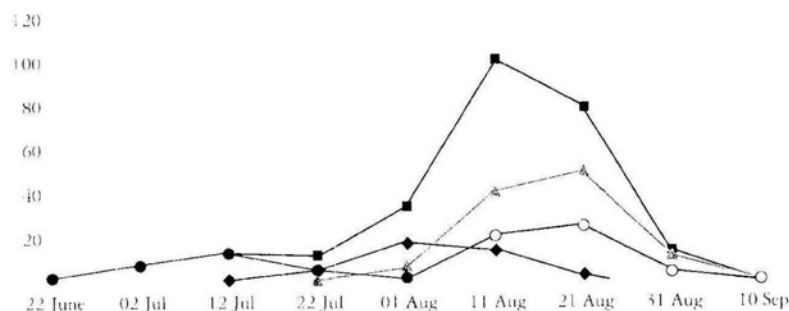
Third, the estimating technique is such that the probability of error leading to an over-estimate of the numbers passing Mission is no greater than the probability of an under-estimate. This leaves little scope for attributing the missing fish to faulty counts of fish entering the river.

Under-estimate of Numbers**Reaching the Spawning Grounds**

As noted earlier, it was originally hoped that 200,000 Early Stuart sockeye would reach the spawning grounds. The news that precipitated the crisis in August was that there were only 45,000 Early Stuart spawners. Since then, the numbers have repeatedly been revised upward, and the latest estimate is 65,000. Correspondingly, the number of Early Summer and Summer spawners have been revised to the estimates appearing in Table 2.

Figure D: Normal Pattern of Entry into the Fraser River by Sockeye Stocks on the 1992 Cycle Year (thousands of fish)

● Early Stuart ○ Stellako ◆ Early Summer ▲ Chilko ■ Total



The numbers of salmon that reach the spawning grounds are estimated through several techniques, the main ones being:

- Mark and recovery.
- Sample counts at weirs.
- Visual counts from river-banks.
- Visual counts from aircraft.

These methods are subject to varying degrees of error. Dr. Larkin reviewed the estimates of the number of spawners for each of the major stocks based on the data available and provided what he considers to be reasonable upper and lower bounds. He concludes that, for the Early Stuart, Early Summer and Summer stocks taken together, the number of spawners lies between 695,000 and 870,000, and his best estimate is 789,000 — the same as the Department's estimate.

Mortality from Natural and Environmental Causes

There is always some mortality of salmon as they fight their way upstream over hundreds of kilometres of river.

High temperatures, low-water levels, fishing nets and physical obstructions in the waterways are common causes of stress and increased mortality. The question here is whether mortality in the river between Mission and the spawning grounds was unusually high in 1992, and whether it can account for the missing sockeye.

Dr. Larkin and our investigation team reviewed in detail the hydrographic information about water levels and temperature on the Fraser and its tributaries in 1992 and previous years. In the Fraser itself, flows were low last summer, but no blockages were recorded and reduced flows are not likely to have caused significant delay or stress to the salmon. Temperatures were relatively high in the lower reaches of the river and in some tributaries, notably the Stuart and Nautley rivers. In the Nechako, flows were maintained near their

regulated maximum and the water temperature was not at intolerable levels for sockeye. Water conditions in the Fraser system were generally within the range of tolerance for salmon.

When large numbers of salmon die in the river they are usually observed. Some sockeye that died before spawning were observed at Bednesti Creek, as in some previous years. Some dead fish were also reported in the Fraser near Quesnel, in the canyon and downstream, but not in extraordinary numbers by historical comparisons. Losses were also reported among the Early Stuart sockeye on the spawning grounds, apparently aggravated by fatigue.

PACIFIC SALMON COMMISSION:

A commission established by the Pacific Salmon Treaty between Canada and the U.S. to allocate catches of salmon stocks that spawn in one country and migrate through the waters of the other.

From a variety of accounts, it appears that significant mortality occurred among Early Stuart and chinook salmon bound for the upper reaches of the Fraser. In addition to any temperature stress they may have encountered, these fish showed evidence of having been hampered by gillnets. When salmon pass through gillnets, some become entangled but subsequently escape. These fish show characteristic net-marks. The effort expended in fighting free of the nets also saps their energy. Experienced field personnel reported that Early Stuart spawners especially, arrived in conspicuously poor condition, with an unusually high incidence of net-marks,

indicating these fish encountered heavy gillnet fishing downstream.

Our conclusion from all this evidence is that mortality among sockeye before they reached their spawning grounds was somewhat higher than normal and in the order of 20 per cent of the Early Stuart stocks that entered the river, 10 per cent of the Early Summers, and seven per cent for the Summer stocks – a weighted average of about 10 per cent.

Under-estimation of Catches in the River

Indians fish all along the river under the special arrangements for the Indian fishery described in the preceding chapter. In 1992, most fished

under the long standing "food fishing" arrangements, but those embraced by the LFEA – the Sto:lo, the Musqueam and Tsawwassen – fished under the terms of the new Agreements described earlier.

When the Department and the Commission designed their pre-season fishing plans for sockeye, they made an allowance for the Indian catch in the river, as shown in the first three columns of Table 4. These estimates of Indian catches, coupled with the desired number of spawners, provided the target number of fish they wanted to escape into the river.

In Table 4 the expected Indian catches in the lower river are shown separately as this area was covered by the 1992 Agreements with the native groups party to the LFEA. Accordingly, the figures for the pre-season plan's catch in the lower river are the actual allocations under the Agreements. The figures for the upper river are expectations based on past experience.

The right-hand columns of Table 4 show the Department's estimates of fish actually caught.

Table 4: Catches of Sockeye Salmon in the Indian Fisheries of the Fraser River in 1992 (thousands of fish)

	Pre-Season Forecast			Department's Post-Season Estimated Catch		
	lower river ¹	upper river ²	total	lower river ³	upper river ⁴	total ⁵
Early Stuart	125	75	200	87	48	135
Early Summer	245	140	385	113	25	138
Summer				109	65	174
Late	25	5	30	7 ¹	0	7
Total	395	220	615	316	138	454

¹ Below Sawmill Creek. Includes both Musqueam and Tsawwassen and Sto:lo fishing under Agreements and estimates for independent bands.

² Above Sawmill Creek.

³ Includes Late stocks and catches below Mission (thus these figures exceed those in Table 2).

⁴ Catches in the Lillooet River system only.

The question here is whether the number of fish taken from the river could have exceeded these estimated catches. There are several reasons to believe that it did:

Fishing was unusually heavy, yet estimated catches were the lowest in four years.

- On the lower river, the number of fishing permits issued by the LFFA exceeded considerably the number of nets authorized in previous years. Fishery officers on patrols on the lower river counted double the number of nets observed in the highest count in previous years.
- On the upper main stem of the river, especially in the canyon, fishing was also extraordinarily intense. Not only were there more fishermen and nets, but fishing, which had traditionally been limited to four days per week in previous years, was almost continuous, unregulated and uncontrolled in 1992.

This, and other evidence of sharply increased fishing does not necessarily mean the catch increased in proportion since that depends on fish abundance, fishing time and other factors. But it supports other evidence that a significantly higher proportion of the runs was caught than the catch estimates suggest.

- During July and the first three weeks of August, when sockeye fishing on the river is at its peak, even the Department's estimates of catches in the lower river are higher in 1992 than in other recent years, though there were fewer sockeye in the river than in previous years. This means that the proportion of the runs removed by fishing was higher in 1992.

Stocks showed heavy exploitation.

- In the preceding two years at least 40 per cent of the Early Stuart sockeye that passed Mission reached the spawning grounds; in 1992 slightly more than 20 per cent did so. In the absence of exceptionally high natural mortality, catches must have been higher than the estimates show.

• Biological observations on the spawning grounds also provide evidence of catches greater than those recorded in previous years. Historically, the incidence of net-marks on Early Stuart sockeye arriving at the spawning grounds has ranged from less than one per cent to as high as 25 per cent. In 1992, 50 to 60 per cent of the fish sampled had net-marks. Similarly, the incidence of marks was two to three times greater than usual for the Chilko and Stellako stocks. For all of these stocks, the occurrence of net-marks was the highest ever recorded. It is a reasonable assumption that the proportion caught in nets was correspondingly greater in 1992.

- The ratio of males to females reaching the spawning grounds also indicates extraordinary rates of exploitation. When sockeye pass through gillnets, more males are caught than females. This is due to the males' body shape. Thus the more nets encountered, the lower the proportion of males in the remaining stock. When the fish enter the river, about half are males. But when the Early Stuart stock reached the spawning grounds last summer, the proportion of males was only 37 per cent. This also suggests heavy exploitation by gillnets in the river.

Estimated catches are too low:

There are several reasons to expect that catches were significantly higher than the Department's estimates indicate.

- The estimates for the lower river are based largely on a catch-sampling technique developed by fishery officers over many years. It involves counting the fish in a sample of nets early in the morning before the nets are "picked" in order to estimate the overnight catch rate, which is then extrapolated to estimate the total catch in all nets over the full fishing time. In 1992 however, "hot picking" – removing the fish periodically through the day or night to improve the efficiency of the nets and reduce the risk of fish being stolen – became common practice. This meant that fewer fish appeared in nets during the fishery officers' morning patrols – often only a fraction of the assumed overnight catch – leading to under-estimates.

Because of the difficulty in obtaining adequate samples with the increased numbers of nets last summer and doubts about the reliability of the sampling system, increased reliance was put on "hailing" – asking fishermen about their catches. However, hail information is notoriously unreliable. Checks on the lower river last year revealed that actual catches were usually more than double the catches hailed.

- Further bias resulted from the common practice of fishing with multiple nets.
- No provision was made in the catch estimates for extra, unauthorized nets used at night, or for nets set before openings and pulled after closures.

For all these reasons, fishery officers on the lower river believe that catches were considerably greater than estimated.

- The LFFA's catch estimate of 190,564 sockeye in total was similarly low, but in this case the problem was not due to the system of estimation so much as the difficulty in applying it. A single monitor at a landing site was expected to count all the fish landed, though in some cases the fish were being landed around the clock, or by many fishermen at once. Reliable reports indicate that catches were often not counted (hail information was often used instead), landing sites were often not monitored at all and fish were often landed in places other than monitored sites.

- The estimated catches on the lower river (Table 4) are less than the sales recorded on sales slips issued by licensed buyers, yet the recorded sales are likely to be considerably less than the total catch:

- Fish kept for food and other traditional purposes would not pass thorough a licensed buyer, nor would fish sold directly to consumers.
- Fishermen were instructed to report any direct sales to consumers, but it is likely many did not do so.

- Fish sold in the U.S., the Okanagan or elsewhere would not be covered by sales slips.

The sales-slip system, designed for the commercial fishery, was not administered consistently. It worked reasonably well in the Musqueam and Tsawwassen area where Indian fishing involves gill-nets from boats, as in commercial fishing, and where a single buyer was designated and landing sites were approved and manned. In the Sto:lo area however, the number of buyers was not controlled; landing sites were not designated; and roads and highways along the river provided easy access to fishing with sennets from the riverbank. Some buyers were not equipped with sales slips early in the season; returned slips were often incomplete, contained inconsistencies or were illegible; and reports of buyers who either failed to issue slips or understated the fish purchased were rampant. There was no enforcement of the sales-slip program.

(It has been suggested that sales records on the lower river may have been inflated by sales of fish brought down from the upper river where sales were not permitted.

However, buyers were permitted to buy fish only from fishermen holding permits issued by the LFFA, and it is unlikely that many such illicit sales were documented in this way.)

- Fishing on the upper main stem of the river was not monitored last summer and the catch estimates were not based on any direct information at all. For this part of the river, the estimates are based entirely on the historical relationship between the harvest rate and the abundance of fish. However fishing effort increased sharply this year, as noted earlier, and this would have increased the harvest rate. As a result the catches would be under-estimated.

All this suggests that considerably more fish were taken than catch estimates indicate.

This led Dr. Larkin to his revised estimate of catches of Early Stuart, Early Summer and Summer stocks of 583,000 sockeye caught above Mission, considerably more than the Department's estimate of 382,000.

Dr. Larkin cautions that the data underpinning these estimates is very weak, and the range of possible error is wide. It is certainly wide enough to account for a large portion of the remaining missing fish.

Some argue that hundreds of thousands of fish in excess of the reported number could not have been handled and disposed of without attracting attention. The evidence leaves little room for concern on this point, however. In 1990, when only about half as much gear was used, the reported catch on the lower river was almost double the estimated catch in 1992. Most of it is believed to have been sold.

Summary

This analysis leads to the conclusion that the shortfall of 482,000 sockeye spawners we began with (in Table 2) can be explained in terms of revisions to the Department's estimates, summarized in Table 5.

The Department's estimates made no explicit provision for mortality. Our estimates attribute a significant portion of the discrepancy to this cause, but much of our estimated mortality consists of fish that either died in nets or from stress after escaping from nets.

Figure E: Spawners, Catch and En-route Mortality of Sockeye in the Fraser River in 1992



- Spawners 50%
- Catch 35%
- Mortality 15%

Note. Dotted line represents uncertainty in the percentage of natural and fishing induced mortality.

In the absence of unusually heavy fishing, natural mortality probably would have been in the normal range, which is in the order of half our estimated mortality. The rest is due to fishing, and is therefore not "natural" mortality in the usual sense. It can be regarded, along with catches, as fishing mortality. Accordingly, we have divided mortality equally between natural and fishing-induced mortality, but this is somewhat arbitrary because the dividing line between these two categories is inevitably blurred.

In the Appendix, Dr. Larkin presents several alternative accountings consistent with the range of the estimate of each variable shown in Table 5. All are considered less likely than the "best estimate" in the Table.

We are confident in concluding that the bulk of the missing fish can be explained by fishing in the river. Most of the unrecorded catches appear to have been taken between Mission and Lytton,

which is partly within the Agreement area and partly beyond it upstream. Above Lil-looet, the abundance of Early Stuart and Early Summer runs was low (to the disappointment of upstream fishermen) as were fishing effort and catches, confirming that the heavy exploitation took place downstream.

We cannot say who took the unrecorded catch, whether they were Indians or not, what portion was taken in the Agreement area, how they were disposed of, or where they went. Nor can we say whether they were caught illegally. We can only say with confidence that considerably more fish were taken than estimated, many more died as a result of intense fishing activity, and much of the catch was sold illegally insofar as official sales slips were not issued for them.

Table 5: Summary of Our Estimates of Sockeye in the Fraser in 1992¹ (thousands of fish)

	Department's Estimate	Our Estimate	
		Range	Best Estimate
Escapement past Mission	1,653	1,521 to 1,785	1,653
Spawners	789	695 to 870	822
Mortality	0 ²	132 to 248	248
<i>natural</i>			
<i>fishing induced</i>			
Catch in the River	382	533 to 633	583
Unaccounted for	482		0

¹ Excludes Late stocks and catches below Mission, as in Table 2.

² Recognized, but no explicit estimate.

IN THE COURSE OF this investigation Dr. Larkin and I learned a great deal about the complex salmon resources of the Fraser and how fishing was managed there in the summer of 1992. We were struck by the special difficulties faced by managers who attempted to reconcile the natural requirements of migrating stocks with changing law, governmental policy and social needs. In many respects, the fishery was managed well. But we also found glaring weaknesses and deficiencies, particularly with regard to the new aboriginal fisheries policy.

We cannot allow the turmoil of 1992 to be repeated. If it happens again, confidence in the management system will be hard to repair, and progress in Indian fishery policy will suffer a serious setback. Most important, valuable salmon resources could be irreparably harmed.

The summer of 1992 provides valuable guidance about what will work and not work in the future.

Keeping Perspective

First, it is important to keep the "missing sockeye" in proper perspective. It is cause for concern when large numbers of salmon seemingly disappear from the river. But 1992 was by no means a disaster. Sockeye returns to the Fraser River were the largest in this cycle in more than 80 years. The catch in the Indian fishery was the highest ever recorded in this cycle, and the commercial catch was exceeded only once in the last 44 years. The number of fish reaching the spawning beds was the second highest for many decades (Figure F).

Even Early Stuarts reached spawning grounds in numbers that were exceeded only once on this cycle since 1960; that was in 1988, when more than 170,000 reached the spawning grounds. Significantly, that was four years (one cycle) after only 45,000 spawned fewer than this year.

Nevertheless, escapement targets were not met in 1992. This is a setback. But these stocks can be rebuilt.

Large discrepancies between the planned and achieved numbers of spawners are unusual but not rare in major salmon fisheries. Both shortfalls and unexpected surpluses have been experienced on the Fraser and other rivers in recent decades. These discrepancies remind us that salmon management is an imprecise science.

The summer of 1992 was not so much a crisis in resource management as a crisis of policy. The "missing sockeye" were variously interpreted as evidence that the new aboriginal fisheries policy was a failure, or that it threatened livelihoods, or that it was the leading edge of reckless policy change. Competing interests waged a media war against each other. The news reverberated around Ottawa and Victoria and, as a result, this investigation was announced.

Signaling a major shift in policy, these pilot projects threatened deeply entrenched interests. Change is often tentative, upsetting and fraught with mistakes. The pilot projects could undoubtedly have been introduced with less disruption, but this is an assessment made in hindsight.

The Agreements were shown to be inadequate to control catches and ensure escapement. Moreover, they contributed to an erosion of public confidence in the fisheries management system. Nevertheless, they succeeded in regulating the Indian fishery in some areas; they engaged Indians in management; and they enabled Indian communities to take economic advantage of their rights to fish. As a result, conditions necessary to achieve the objectives of the Strategy are now in sharp focus.

Essential Conditions for Success

Judgments about the government's new policy are beyond my terms of reference. But it does appear that the government now has a duty, under law, to try to negotiate arrangements for Indian fishing.

Important lessons can be learned about how the new policy can be implemented. This investigation has led me to conclude that fishing agreements of this kind can be reconciled with proper management of the resource – but only if certain conditions are met.

All participants must be committed to conservation.

First and foremost, all parties must be committed to the protection and conservation of the resource. Virtually everyone – commercial and sport fishermen, Indians, environmentalists and governments – pays lip service to this notion. But each has a tendency, when the resource is under pressure, to resist bearing the burden of restraint and to blame others.

Public confidence was seriously damaged by last summer's events. To regain this confidence those involved must be seen to practise what they preach when it comes to conservation. Simply put, this means collective commitment over self-interest.

Sustainable development is now a widely accepted concept. The Fraser basin is the ideal place to set it in motion. Fraser salmon can not only be sustained; they can be enhanced considerably.

Indian groups must work together.

The government cannot negotiate agreements separately for every band or tribal group. The different arrangements on the upper and lower parts of the Fraser exacerbated management and enforcement difficulties. Moreover, the authorization of sales in some areas aggravated the problem of managing the traditional Indian fishery elsewhere, especially on the coast. A piecemeal approach spells only trouble.

Ideally, all tribal groups in B.C. would agree to negotiate collectively with the government to enter into an interim fisheries framework agreement, consistent with the broadly accepted recommendations of the B.C. Claims Task Force.

Even more urgent is a river-wide agreement embracing all Indian communities on the Fraser. Co-management arrangements and commercial sales of Indian catches make river-wide co-ordination essential. It is now widely understood among the Indian communities that such an arrangement is required for managing escapements through the succession of fishing areas on the river; for sharing access and available catches; for facilitating habitat management and enhancement; and for co-operating in surveillance and enforcement. It is imprudent for the government to proceed otherwise.

Tribal groupings and bands in the Fraser basin face widely differing circumstances and have differing aspirations. These must be accommodated in order to reach agreement and can best be done with sub-agreements for particular bands or groups of bands. Sub-agreements can specify differing activities and responsibilities. All should set out the proportion of the community's fish to be used for traditional purposes, but that proportion can vary.

These arrangements should be designed to facilitate contractual arrangements among Indian communities. For example, those in the upper tributaries of the Fraser system are in the best position to enhance fish production while those on or near the coast can harvest them to best commercial advantage, affording opportunities for mutual gain.

Native groups themselves must work together to affect these changes. Efforts are already being made to bring all First Nations in the province together to try to negotiate with the federal government an interim fisheries framework agreement and, under other auspices, the prospects for a comprehensive approach to the Fraser fishery are being explored. The government should support these efforts and move as quickly as possible.

Fishermen and managers must be accountable.

Each interest group — particularly their leaders — must be responsible and accountable. Native groups entering into contractual agreements must guarantee they fulfill their undertakings. This means complying with the agreed rules of fishing, co-operating with the Department, providing complete and reliable information about catches and sales, and managing funds carefully. Anyone who abuses the system must be exposed, not only to protect the resource but also to protect the integrity of the system itself. Leaders must communicate these responsibilities to their people.

Commercial and sport fishing groups must take more responsibility for communicating information to their members and participating constructively in policy development. They have a public duty to insist that consultative bodies that represent them do so in a balanced way. They must make a special effort to inform their constituents about changes in the law and government policy, even if they dislike it.

Victoria must take responsibility for regulating fish buyers much more rigorously in the future. The deficiency in Ottawa's role is underlined by the need for this investigation in the first place.

At the highest level, the government has an obligation to make its policy clear and to communicate it to those affected. This includes the public servants expected to administer the policy; they must be given direction when they need it, not left unsure as they were last summer.

Strict enforcement.

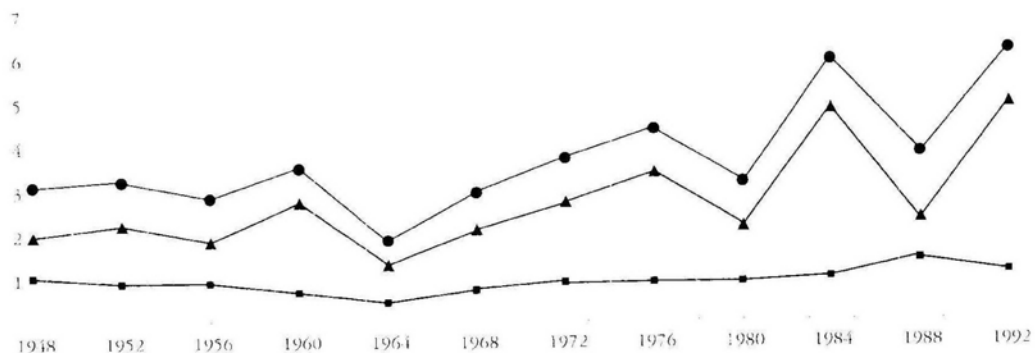
Probably the biggest single obstacle to progress in developing new policy is the widespread perception that fishing was out of control on the Fraser last summer. Events fostered a general impression of disarray and abuse in the fishery. For many, including commercial and sport fishermen, support for the new policy is conditional upon strict enforcement of regulations.

Several developments combined to weaken enforcement on the Fraser last summer: a change in long-established policy toward the Indian fishery; new commercial incentives to circumvent the rules; uncertainty about the law and unclear enforcement. People active in the river fishery had the impression that, in some areas at least, offences were being committed with impunity.

When offenders are not punished, more offences often result. This phenomenon took place on the Fraser last summer, especially when news spread that fisheries officers were instructed not to lay charges against Indian fishermen. For sports and commercial fishermen, the resulting cynicism toward fishing regulations was aggravated by their perception of unfair

Figure F: Fraser River Sockeye on the 1992 Cycle Year (millions of fish)

■ Escapement ▲ Catch ● Total Run Size



treatment. Many Indian leaders were concerned that unapprehended abuses would reflect on them. Fisheries officers, for their part, became unhappy targets of criticism and lost the confidence of both groups.

Any new Agreements must have strong enforcement designed to generate the support and co-operation of native signatories through joint programs, monitoring and surveillance. This cannot be achieved without the active participation of native people. But since these Agreements are made under the authority of the Fisheries Act, the Department must accept ultimate responsibility for enforcement. It follows that, while enforcement might well reduce demands on government resources in the long run, this reduction cannot be expected until a system is well established.

The preceding four conditions are prerequisites for successful co-operative management. But other matters must be addressed.

Communication

Lack of reliable information about the new Agreements was a common complaint, leading to suspicion and fear. Indian communities said poor communication created resentment against them. Victoria was caught off guard. Federal field staff complained they were not consulted, and as a result, felt left out. Even the B.C. Fisheries Commission, charged with providing advice on these matters, protested it was not kept informed. Indian communities party to the Agreements complained they were caught uninformed. Confusion prevailed.

There was also poor communication inside the Department, specifically between senior officials who negotiated the arrangements and regional and field staff responsible for implementing them. Field staff were understandably anxious about the practical realities of managing the fishery. For their part, officials in Ottawa were trying to reconcile fishing Agreements with policies from the Departments of Indian and Northern Affairs, Justice and Finance to say nothing of developments in constitutional discussions, land claims, court decisions and economic development.

Any major shift in public policy calls for good communication. In the high-stakes, hothouse atmosphere of these fisheries, it is essential. Real communication also implies active listening. In the summer of 1992, some people turned a deaf ear.

It is particularly important to clearly communicate the objectives of the policy. The Aboriginal Fisheries Strategy is intended to respond to new requirements of the law and to treat native people fairly — without causing dislocation to others. At the same time it is designed to improve economic opportunities of native communities in utilizing fish and in sharing management responsibilities. Shared management is a means of advancing conservation and enhancement and reducing governmental costs. These goals are not widely known or understood.

Consultative Structures

There are a variety of advisory bodies and councils concerned with fisheries in B. C.; I want to comment on those most closely linked to the Fraser salmon fisheries and the new Agreements.

Consultation on Fisheries Management

The Agreements entered into on the Fraser in 1992 were managed, on the native side, by the LFFA. The LFFA and the Department established a Joint Technical Committee, consisting of experts from the Department and native groups party to the Agreement. It was set up to resolve technical problems in managing the fishing and other activities under the Agreement. The committee seems to have worked well; the participants developed a rapport and mutual trust and resolved many technical problems.

Difficulties arose however, when the problems dealt with raised policy issues that had to be resolved at a higher level. Federal authorities, especially, were not sufficiently responsive during the fast-paced fishing season. Provision should be made, in any framework agreement of the kind suggested earlier, for a joint consultative body capable of dealing with such broader questions as may arise in implementing Agreements.

Consultation with Other Interest Groups

During the last couple of years the Department has consulted with other interest groups about the development of the Aboriginal Fisheries Strategy. In addition to the pre-existing consultative bodies in the Pacific Region, senior officials have held a series of so-called Dunsmuir meetings with leaders in the commercial, sport and Indian fisheries. Responding to a proposal from participants in the Dunsmuir meetings earlier this year, the Minister established and funded the B.C. Fisheries Commission to represent the commercial and

sport sectors in providing advice on the development of the Aboriginal Fisheries Strategy and to communicate progress to its constituents. As noted earlier, the B.C. Fisheries Commission was also given the task of advising the government on the best way to utilize \$7 million in retiring commercial fishing enterprises to facilitate the new policy.

Assessments of the Commission's effectiveness are mixed. We heard many criticisms of its performance in providing advice to the government and in communicating policy developments to commercial and sport fishing groups. The Commission itself feels it has not enjoyed the confidence of the government in sharing information. Also, it apparently lacks the confidence of some groups it is intended to represent. The structure and function of this body should be reassessed.

Inter-agency Liaison

Management of the salmon fisheries involves a complicated mosaic of agencies – the Department, the Commission and its Fraser Panel, the B.C. Commercial Fisheries Branch and the bodies associated with the Indian fishery mentioned earlier. The new developments in Indian fisheries policy call for review of the present division of responsibilities.

One such question relates to the responsibility for collecting and analyzing data about fish stocks and catches. At present this responsibility is divided between the Commission and the Department, although the agencies depend on each other's information. If the river fishery is to be developed in ways which will be much more demanding of information about migrating stocks (to forestall problems of the kind that gave rise to this inquiry) the responsibilities of these agencies will have to be re-examined to ensure that the system as a whole produces the most timely and useful information.

The regulation of fish buyers is another issue. As noted earlier, provincial regulations governing fish buyers on the Fraser last summer were not rigorously enforced, ostensibly because of short notice of the authorization of commercial sales in the Indian fishery. Better arrangements will be needed to ensure the quality of fish is protected, health standards are maintained and records of sales are reliable. Provincial authorities should be encouraged to strictly enforce applicable regulations. Since federal agencies already license the processing plants that handle fish for export, an alternative arrangement would be to assign these responsibilities to the federal government.

Consultation on Broader Issues of Indian Fishery Policy

Finally, I should report that some native groups, mainly on the upper Fraser, expressed a need for a forum to consider broader issues of Indian fisheries policy, such as their rights to quantities or shares of migrating stocks. Some of these matters would be dealt with in the context of river plans of the kind advocated here. Others seem to be matters for negotiation in settlement of claims. But the expressed need for a forum to deal with such issues should be acknowledged and, if other mechanisms prove inadequate, something additional should be created.

Agreements

I have already pointed to some difficulties associated with the Agreements entered into in 1992 which should be avoided in future, such as the lack of preparation for implementing them, the inadequate consultation with field personnel and the differing treatment of Indian communities. Here are some specific problems:

Guardians

The Agreements provide for native guardians to assist with surveillance of the fisheries and some enforcement functions (excluding the laying of charges). These arrangements were frequently criticized on several grounds. One was that the guardians were inadequately trained, which is a reflection of the general problem of insufficient advance preparation last year. Another was that some guardians were fishermen themselves and therefore had an obvious conflict of interest. A third was that guardians were often stationed where they were expected to enforce regulations against family members and relatives. These problems must be avoided in future.

Landing Sites

The Musqueam and Tsawwassen group, which fishes from boats with nets, designated particular sites for landing fish under their Agreement, thus facilitating the recording of catches. Up-river, Sto:lo fishermen fish mainly from the shore with set gillnets; the designated landing sites were not enforced. Last summer's experience suggests that in order to maintain accurate records of catches it will be necessary to identify certain sites to which catches must be brought for that purpose.

Control of Fishing Effort

There was no limit on the number of fishing permits issued in 1992 and thus the numbers expanded significantly. The result was crowding of fishing sites, friction, and difficulty in managing orderly fishing and fish migration. Fishing effort, and the number of nets in the water, must be controlled. Since the native communities themselves are in the best position to deal with the allocation of permits, future Agreements should call on them to control the amount of gear within an agreed limit.

Urgency

Finally, I want to stress the urgency of careful planning before any new agreements are struck. Many of the difficulties in the summer of 1992 were due to the arrangements having been made at the eleventh hour. This must not be repeated.

If the new policy is to move ahead next year preparatory work on new Agreements should therefore start immediately. Evaluations of the summer of 1992 should begin without delay. Native leaders should meet to explore the possibilities of collectively entering into a framework agreement and a co-ordinated plan for the Fraser. The time to start is now.

*For additional copies of this report
please contact the nearest Department
of Fisheries and Oceans office.*

Technical Appendix

ANALYSIS OF POSSIBLE
CAUSES OF THE SHORTFALL
IN SOCKEYE SPAWNERS IN
THE FRASER RIVER

by P. A. Larkin

(published separately)

*This booklet is printed on paper made
from recycled fibre.*

Design: Dave Mason & Associates

Editor: Alex Rose

Printer: H. MacDonald Printing

November 1992

