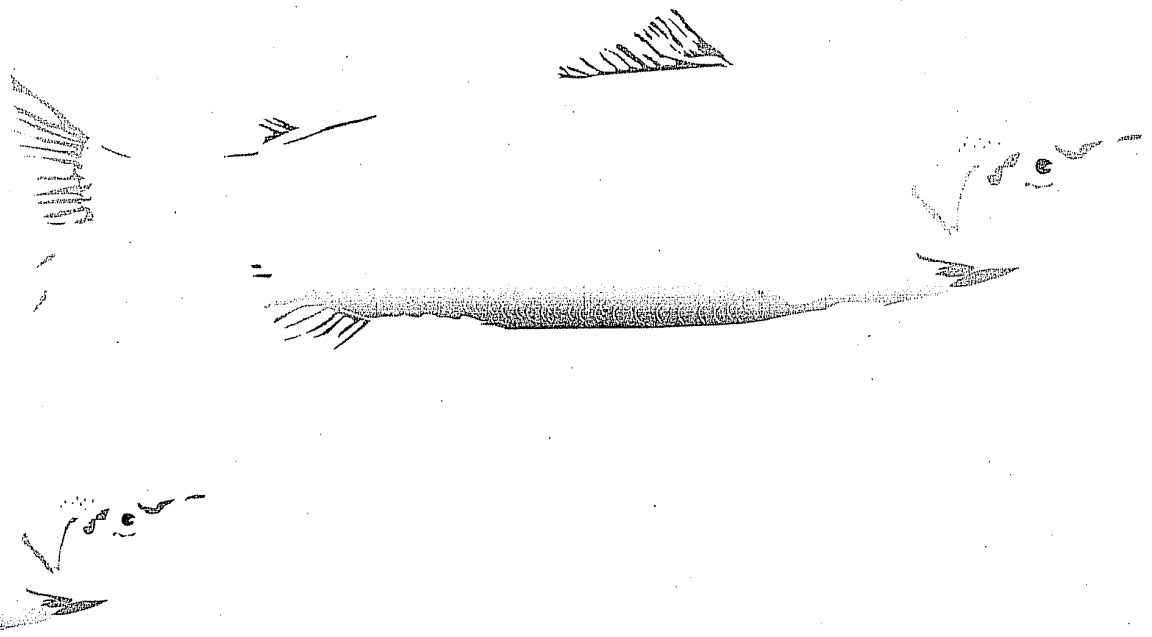


# *Fraser River Sockeye 1994*

PROBLEMS & DISCREPANCIES



*Fraser River Sockeye 1994* ♦ PROBLEMS & DISCREPANCIES



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PROBLEMS & DISCREPANCIES

Report of  
The Fraser River Sockeye Public Review Board  
1995

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- Dr. John Davis, Regional Director, Science
- Mr. David Innell, Regional Comptroller
- Mr. Terry Tebb, Regional Director, Management Services Branch
- Dr. Mike Henderson, Head, Stock Assessment Division
- Mr. Lew Edwardson, Regional Manager, Contracts and Procurement



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## Preface

*In late September 1994, the Minister of Fisheries and Oceans appointed an independent review board under the chairmanship of Dr. Paul LeBlond which included Mr. David Brander-Smith, Q.C., Dr. Joseph Scrimger and Dr. Richard Routledge when a discrepancy of an estimated 1.3 million Fraser River sockeye was discovered. In early October, a further shortfall in the Late run, which includes the famous Adams River run, led to the establishment of the Fraser River Sockeye Public Review Board under the chairmanship of the Hon. John A. Fraser, P.C., Q.C. and included, in addition to the above members, Dr. Lee Alverson. The following is a message on behalf of the Board members from the Chairman.*

My fellow panel members and I were asked by the Government of Canada, and specifically the Honourable Brian Tobin, Minister of Fisheries and Oceans, to solve a disturbing and puzzling mystery which surrounded the dramatic apparent disappearance of several million sockeye salmon which normally would have migrated to spawning areas in the Fraser River watershed in 1994.

Some of these salmon went missing after having been counted while swimming upstream past the Pacific Salmon Commission echo sounder device at Mission. Later in the summer, the Adams River run into the Fraser River was significantly less in numbers than had been estimated in Johnstone Strait. The missing salmon phenomenon has been the subject of much concern, at times anger, and certainly dismay, which has been conveyed to the public of our province, our country and internationally by the media. To paraphrase the ancient confessional, some things have been said that ought not to have been said, and some things have been left unsaid that ought to have been said. However, the public outcry reflects the depth of feeling that we in this province have for this magnificent and beautiful land we call home, and, in other places, the outcry reflects the anguish of people far away who know that they too are diminished when the magic cycle of life in any part of the world is put at risk.

Some of the reaction has been extreme, some of it exaggerated, and no doubt, some of it self-serving. On balance, though, hundreds if not thousands of citizens have asked: What is going on? How could this happen? Are salmon to go the way of the cod? Who is at fault, or to blame? And some have suggested that the nation — and we, as individuals — are all to blame because this shows a failing to exercise wise stewardship over a precious resource.

The Board has operated under certain terms of reference which were determined after careful discussion with Board members, Department of Fisheries and Oceans (DFO) officials and the Minister of Fisheries and Oceans. The review of Fraser River sockeye management had three main objectives: first, to identify the reasons for the discrepancies in the expected and actual number of sockeye salmon arriving on the spawning grounds; second, to evaluate the accuracy of the Pacific Salmon Commission's methodology for estimating run sizes and sockeye escapement in the Fraser River; and, third, to make recommendations on how any deficiencies can be corrected, beginning in 1995. The full Terms of Reference are contained in the Appendices of this Report for reference.

The Board was organized to conduct an independent investigation of these issues involving active participation of all interested parties and stakeholder groups, major organizations and agencies. Meetings, consultations and discussions were held with a broad cross-section of stakeholders and the public, utilizing an open process that allowed the fullest possible access to Board members. Nearly 1,000 letters were addressed to various stakeholders and others. The Board advertised extensively throughout the province, soliciting participation from the public at large. An information line was set up and more than 3,000 calls were received during the period of the inquiry. Over 130 formal submissions were received, and 10 days of public meetings were held throughout the province.

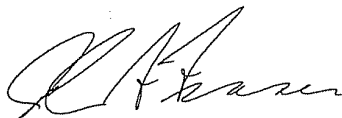
The Board was offered full access to all relevant DFO files and personnel. As well as conducting its own research, the Board received four reports of the technical findings of an internal management team established by DFO. From among the many individuals with whom we came into contact in the Department, the Board discerned a very sincere desire not only to help with our mandate, but also a strong willingness to correct the situation which currently exists. As a consequence of the discussions during the period of the inquiry we understand that some changes have indeed already been initiated by DFO.

## *Preface*

We are grateful to all who have taken the time and effort to participate in our mandate: to the officials and staff of the Department of Fisheries and Oceans, the Pacific Salmon Commission, the Government of British Columbia and particularly to all the many stakeholders and the general public who came forward and contributed so generously to our work. We wish to convey our sincere appreciation to all.

None of our efforts as a Board could have been converted into a coherent report without the intensive work and dedication of our staff. Under the direction of our Executive Director, Sheila-Marie Cook, experts and apprentices were brought together to complete this enormous task. We gratefully acknowledge their excellent work. The responsibility for the conclusions and recommendations, however, remains ours.

This was not an all-inclusive inquiry into the ecology of this province and the Pacific Ocean as it relates to all species of fish. Rather, this inquiry was about the salmon and about us, who have the responsibility to protect and manage the salmon in such a way that there will always be salmon returning to the rivers and streams of the west coast of North America. Our responsibility goes beyond the boundaries set by interest groups, stakeholders, sovereign states and the chronology of time which marks each passing generation. This is about these magnificent fish, and all of us, who have the tendency to destroy, but also the capacity to protect and conserve. No one owns these fish, even less does any particular interest group. This resource is held in trust by all Canadians for each succeeding generation of our peoples. It is in this spirit that we, the members of the Fraser River Sockeye Public Review Board, prepared this report. We submit it to the Minister on behalf of all who contributed to our mandate — the people of British Columbia and Canada.



The Honourable John A. Fraser, P.C., Q.C.  
Chairman





## *Executive Summary*

This report contains the findings of the Fraser River Sockeye Public Review Board. The Board was formed in the Fall of 1994 by the Minister of Fisheries and Oceans and mandated to investigate various aspects of the apparent disappearance in that year of more than a million sockeye salmon expected to return to spawning areas throughout the Fraser River watershed.

The Board's Terms of Reference contained six specific elements. The first four involved thorough review of the reports emanating from working groups established by the Department of Fisheries and Oceans (DFO) to study technical aspects affecting the accuracy of measurement and estimation techniques utilized by the various authorities. The last two tasks were to study the methodology utilized by the Pacific Salmon Commission (PSC) in making its estimates, and to review and comment upon DFO's systems for management, monitoring, surveillance and enforcement.

The Board is grateful for the various submissions and comments made during public hearings, and particularly appreciative of the cooperation received from officials of DFO, PSC and the Government of the Province of British Columbia, who made themselves and their records available to make our task easier.

This report, at the first level, responds to our six terms of reference. It contains a technical assessment of the various estimation techniques utilized in calculating the size of salmon runs and spawning escapement. It also examines the situation with respect to the role which environmental factors might have played, given the higher than normal water temperatures prevailing in key areas of the Fraser River watershed during the summer of 1994. We review the nature of the institutions involved and the management techniques employed, and make recommendations regarding the management of risk within the salmon fishery. At a second level, the report addresses the nature and effectiveness of management including the enforcement system. In doing so, the Board examines the evolution and impacts of the federal government's Aboriginal Fisheries Strategy and explores ways to make the program more effective. Finally, the roles and responsibilities of various user groups complete our *tour de table*.

The report attempts to reflect what we heard and read, and to draw upon the expertise of Board members, whose backgrounds span government, law, fisheries management, oceanography and statistical modelling. The technical details of our review and the details of our recommendations can be found in the body of the report, which is presented in three chapters and a series of appendices. What we hope to convey in this brief section is the essence of our message.

That message is simple: if something like the 1994 situation happens again, the door to disaster will be wide open. According to what the Board found, one more 12-hour opening could have virtually eliminated the Late run of sockeye in the Adams River. Such an occurrence would have devastating consequences for the Pacific fishery, delaying stock rebuilding efforts by years and bringing dire economic consequences to the province. The Board believes that the solution to this problem lies in fixing the system. Unless all parties work together and manage much more competently, the tragedy that befell the Atlantic cod fishery will repeat itself on the west coast.

What brought us so close to disaster's door? The scenario has its roots in the 1992/93 DFO Pacific Region reorganization. Cutbacks and budget reductions were made to the extent that the Department was left in charge without the clear lines of accountability or necessary tools to enforce its regulations with any credibility. In the midst of this confusion, the Aboriginal Fisheries Strategy was beginning to take hold and the early evidence suggests that it too was not working as intended. Once again, there was confusion as to who was in charge, obviating effective enforcement.

The attitudes created by the DFO reorganization, compounded by ongoing federal austerity programs, created an atmosphere of uncertainty and total lack of confidence both within the Department and from the outside. Well into the 1994 salmon season, when reports of abnormal numbers of missing sockeye were made public, some DFO officials were in a state of denial as to the existence of a problem. They certainly were in no position to develop a solution. In this chaos, blame was found everywhere, and little attention was paid to the core problem: the system had become dysfunctional. The events underlying this situation are explored in more detail in the main report.

Although the task of managers was complicated by run diversions and illegal fishing, the Board believes that an over-reliance on the quality of historic in-season estimates and an optimistic attitude regarding the run size fostered risky management decisions in 1994. The total harvest rate for sockeye approached 80 percent of the late

in-season estimated total run size, hardly reflective of a management system that recognized and accounted for the cumulative risk factors at work. It appears to the Board, in fact, that the various techniques used to estimate both pre-season and in-season catch, run size and run timing were on occasion used to make management choices without consideration of the underlying risks involved. This revealed a troubling laxity of diligence. The system was not able to cope with ongoing changes to both the traditional commercial and Aboriginal components of the fishery. This more than likely pushed the management system beyond its capacity. The Board reviews the nature of management, and presents a case for adherence to a risk aversion management system.

The report also addresses the methods used by PSC to predict returning run strength and escapement. PSC was created pursuant to the Canada-United States Pacific Salmon Treaty of 1985. The Commission has management authority that is limited to sockeye and pink salmon fisheries within Fraser River Panel waters. It is, by and large, an advisory body on matters relating to all salmon stocks which originate in one country and are susceptible to interception by the other country. PSC's goal is essentially conservation. Its Fraser River Panel's management was complicated in 1994 by the inability of the two signatories to reach agreement under the Treaty. Subsequent to the Minister's announcement on July 28, 1994 that Canada was withdrawing from negotiations under the Treaty, the Canadian and American sections of the Panel met independently to determine fishing strategies. Although the exchange of technical information continued, Canada made a policy decision to pursue an "aggressive fishing strategy." Canadian fishers were encouraged to harvest as aggressively as possible on the west coast of Vancouver Island and in the Juan de Fuca Strait before the Fraser River sockeye became vulnerable to American interception closer to the mouth of the Fraser River. Ultimately, this strategy was largely unnecessary because of the high diversion rate of sockeye salmon through the Johnstone Strait rather than down the west coast of Vancouver Island. The strategy did, however, contribute to a "grab all" attitude in the Canadian commercial fleet, and a corresponding removal of any moral responsibility for conservation on the U.S. side. These difficult circumstances helped create the "12 hours from disaster" scenario.

The Board makes a number of recommendations for improving the system. In the area of management, we urge DFO to exercise its constitutional conservation responsibilities and not abrogate its stewardship of resources under federal jurisdiction. We recommend that DFO implement better analytical and planning systems and, along with PSC, develop a system for risk-aversion management, particularly given the uncertainties inherent to the various estimation techniques.

The Board believes there is a need for clearer lines of authority and accountability between DFO in Ottawa and the Pacific Region and among the various Departmental branches within the Region. Poor communications precipitate poor enforcement. Improved communication channels between DFO and PSC would enhance joint efforts to conserve the valuable salmon resource. Similarly, better communications between these organizations and First Nations in the Fraser River watershed would enhance efforts to implement co-operative fisheries management agreements and to carry out effective enforcement. Moreover, there is an equally strong need to solidify communications links with the commercial and recreational sectors.

Though we do not believe that commercial sales within the Aboriginal fishery should be extended at present, we are convinced that all First Nation communities in the mid and up-river areas must be involved in the overall in-river management of fish. These communities must be consulted respecting DFO's fisheries plans each year and be offered the opportunity to suggest alterations to those plans and to attend meetings in order to have input into the decision-making process, particularly with regard to escapements. The Board makes a number of recommendations with regard to improving arrangements with First Nations regarding Aboriginal fishing activity and the pilot sales agreements reached with some communities.

The Board also makes a number of recommendations regarding the roles and responsibilities of the commercial and recreational sectors of the salmon fishery. We support the "user-pay" principle for a landing verification system, and encourage industry participants in the salmon fishery to work co-operatively with DFO to develop and implement a peer group system for reporting to DFO illegal catch, sale and transportation of fish. Improving the catch reporting system is essential, as it is clear that DFO cannot properly conserve fish stocks without reliable catch data.

Among the Board's 35 recommendations for improving the management framework and communications channels, there is one unique recommendation which merits discussion in this summary. The Board believes that an independent Pacific Fisheries Conservation Council should be established to act as a public watchdog for the fishery, to report to Ministers and the public annually and any other time it is deemed necessary. The Council would have no vested interest except the health of the fish and their habitats. It would operate more on the principle of moral suasion than through direct

## *Executive Summary*

regulation. It could be initiated via a Memorandum of Understanding, and its mandate would encompass all species of fish in the Pacific Region, both commercial and non-commercial. The Council would be strictly independent. This, in the Board's view, is an essential condition for building public confidence in the fairness, rationality and effectiveness of fisheries resource conservation policies, priorities, strategies and activities.

This report is not about people and institutions; it is about the sockeye salmon, and the need for all stakeholders to work together to conserve and protect those salmon for future generations. The framework for such co-operation lies within a system where all participants in the fishery are accountable to the Minister of Fisheries and Oceans, who has the constitutional responsibility to protect this valuable resource, and who must have the proper tools and relationships to enforce that authority effectively.



# 1

## *Introduction*

### **THE IMPORTANCE OF FRASER RIVER SOCKEYE**

*... The people of this land and the salmon of our seas and rivers share a common spirit. The salmon moving up and down the Fraser and out to the farthest reaches of that great river's tributaries give life to this piece of the world in the way that nervous pulses up and down our backbone and out to the farthest reaches of our arms and legs give life to our bodies. It is the salmon that express the force of our land. Without the salmon, the land and the rivers would only survive as a corpse survives the death of the nervous system and the departure of the spirit.*

Alan Haig-Brown, Forward to *Adam's River: The Mystery of the Adams River Sockeye* by Mark Hume

Since prehistoric times, the salmon have existed in what is now British Columbia, and residents of the region have depended upon them for their livelihood.

Of the various species of Pacific salmon still running in the Fraser River<sup>1</sup> the sockeye are the most commercially valuable. The extraordinary and mysterious life cycle of the sockeye is an often discussed symbol of birth, death and renewal.<sup>2</sup> Scientists have never fully understood how these unique creatures with their finely tuned navigation systems make their way thousands of kilometres from the North Pacific back to the precise streams and eddies of their origin in the Fraser River watershed. It has been demonstrated, however, that salmon have an extraordinary sense of smell which aids them to find the streams where they were born.

Fraser River sockeye salmon are known to have a four-year cycle, and the 1994 sockeye run thus had its start in the fall of 1990. Returning female sockeye throughout the Fraser and its tributaries dug their nests and deposited their eggs in clusters, called redds, in the gravel of the streams where they themselves had been spawned. After immediate fertilization of the eggs by male sockeye, the female spawners, close to death, covered the eggs and guarded them for as long as possible.

In the spring of 1991, millions of baby sockeye, called alevins, emerged from the gravel. After spending a year or so as fry in nearby lakes, they swam down the Fraser River to its estuary, and then migrated thousands of kilometres into the North Pacific.



Fighting high odds from a combination of factors including unfavourable ocean temperatures and scarcity of foods such as zooplankton, many young sockeye did not survive. Even more succumbed to a variety of predators — from natural ocean enemies to human harvesters.

Those Fraser River sockeye that survived covered vast distances during two years of continuous ocean travel. Eventually, in the spring of 1994, about 16.5 million adult

*... just be a salmon for a minute and see the tension and the strain that he's going under. He's been hit with the trollers, he's been hit with the seiners, he's been hit with the gill-netters, and then when he gets above the bridge into a narrow spot he gets hit ... again and again.*

Mr. Doug Massey, November 25, 1994, Vancouver

sockeye, answering a primeval call, began their long journey home. Having survived two winters at sea and overcome a series of challenges, these salmon represent only about one quarter of one percent of the eggs laid by female sockeye at the beginning of the four-year cycle.<sup>3</sup>

Salmon have two possible routes back to the Fraser River: skirting the west coast of Vancouver Island and into Juan de Fuca Strait,

or along the inside passage of Johnstone Strait. After making it past Alaskan net fisheries and a Canadian ocean troll fishery, the salmon must swim a gauntlet of hooks and nets along both routes. Upon arriving at the Fraser River, most of the sockeye move directly upstream, though some — such as the Adams River run — may pause for

three to six weeks off the mouth of the river before proceeding upstream on the last leg of their arduous journey.

*Even producing at half its historical level it is the greatest salmon river on the planet. And its potential is amazing. The run of more than 22 million salmon that came back in 1993 could be doubled — and that figure could possibly be doubled again.*

Mark Hume, *Adam's River: The Mystery of the Adams River Sockeye*

During their upstream migration, the sockeye undergo marked physical changes. The silvery hue of the sea-going sockeye transforms completely into shades of green and red. The male develops a marked hump on its back. The salmon stop feeding and, while in

the freshwater environment, depend on their energy reserves for both locomotion and development of eggs and sperm. The sockeye that successfully battle the treacherous currents of the Fraser canyon to scramble up fish ladders at Hells Gate arrive, at last, at their ancestral spawning grounds.

The salmon returning to spawning beds on the tributaries of the Fraser River are categorized into four runs: Early Stuart, Early Summer, Summer and Late run which includes the Adams River run.

For every 10 mature sockeye returning to spawn, about eight are taken by the commercial, Aboriginal and recreational fisheries, leaving but a single pair to escape to the spawning grounds.<sup>4</sup> Even at that, the Fraser River watershed is the major producer of sockeye salmon in British Columbia and one of the most productive natural watersheds in the world.

## MAJOR EVENTS PREDATING THE 1994 "DISAPPEARANCE"

In the days of Alexander Mackenzie, salmon were abundant along the length of the Fraser and its tributaries. Aboriginal communities used as much salmon as they wanted without jeopardizing the stocks. The sockeye became an important aspect in the lives of early settlers. Beginning in 1830, cured salmon and other fish were exported, and the salmon industry soon eclipsed the value of the fur trade. It was not until after the Gold Rush of the 1850s and 1860s that the industry shifted from the export of salted fish to large-scale canning of Pacific salmon. The first cannery opened on the Fraser in 1866, at New Westminster. The number of canneries on the river increased steadily thereafter.

By the 1890s, the American catch of Canadian-spawned sockeye caused concern within the B.C. fishing industry due to both Canadian claims of ownership and con-

flicting regulatory schemes in the two countries. Even at the turn of the century, the supply seemed inexhaustible. With such abundance far exceeding industry's capacity, the emerging industry concerned itself more with technical and marketing issues and gave little thought to environmental or conservation problems.

By the next decade it became apparent that the supply of sock-

eye was limited. The long-term viability of the sockeye fishery was affected by increased fishing intensity in both the United States and Canada.

Events at Hells Gate in the Fraser canyon in 1913 and 1914 proved catastrophic to the environment and the Fraser River salmon. The drainage from most of the Fraser River watershed passes through Hells Gate, an extremely narrow gorge in the Fraser canyon about 260 kilometres upstream from the ocean. It has long been recognized

*[1901] The catch that year was so great that every one of the canneries on both sides of the international line filled every can they had or could obtain; and in addition ... millions [of fish] ... which could not be used ... were thrown back dead into the water.*

J.P. Babcock, *Annual Report of the [B.C.] Commissioner of Fisheries*, 1909

as a difficult migration point for returning salmon. Construction by the Canadian Northern Railway (later Canadian National) along the east bank of the canyon near Hells Gate resulted in large amounts of rock being dumped into the river in 1911 and 1912, changing its flow pattern. In 1913, in spite of a record commercial catch of over 32 million

*We're still following I think from policy processes that were developed at the turn of the century based on the reality that at that point in time you could walk across the Skeena estuary on the backs of the salmon. It was considered to be an infinite resource, as at one point the policies that drove the forest industry made the same assumption.*

Mr. Mark Duiven, Chair, Skeena Fisheries Commission, January 9, 1995, Prince Rupert

fish, observers noted huge numbers of sockeye jammed below Hells Gate, unable to reach their spawning grounds. This set the stage for a staggering decline in future production. Recognizing the problem, provincial and Dominion authorities began efforts in late 1913 to remove some of the rocks from the river at Hells Gate.

In 1914, however, a huge rock slide along the east bank of the canyon made matters even worse.<sup>5</sup>

With their passage blocked, millions of salmon died and their carcasses lined the river's edge below Hells Gate. By March of 1915, after more than 60,000 cubic yards of rock had been removed, Canadian engineers, scientists and industry representatives believed that river conditions had been restored. Nevertheless, the dominant run catch had dropped to only 1,685,000 fish by 1921. There were no further man-made changes at Hells Gate until the 1940s. In the

*Yes, there are more — there's no question — in all sectors of the fleet, not just the seine fleet, vessels are more modern, more electronics, better capability to catch fish.*

Mr. Mike Hunter, Fisheries Council of B.C., November 29, 1994, Vancouver

late 1930s, biologists documented their findings that the average commercial catch on the Fraser River sockeye run in the post-Hells Gate period was only 25 percent of that prior to the 1913-14 catastrophe.<sup>6</sup>

A long rebuilding process over the ensuing decades has increased the Fraser River sockeye runs, but they are still below historic averages.

Ever-increasing efficiency within the commercial fleet, environmental issues and unresolved domestic and international policy considerations, however, pose a challenge to today's fisheries managers in their attempts to conserve salmon stocks.

## INTERNATIONAL ARRANGEMENTS

Canada initiated efforts in the early 1900s to negotiate arrangements with the United States on management of the salmon resource. In 1908, the first Salmon Convention

*Once you start dealing with salmon, you tap into all other natural resources. Everything from logging to mining all ties in with the water, with the salmon.*

Mr. Joe Alphonse, Ts'ilhqot'in National Government,  
January 12, 1995, Williams Lake

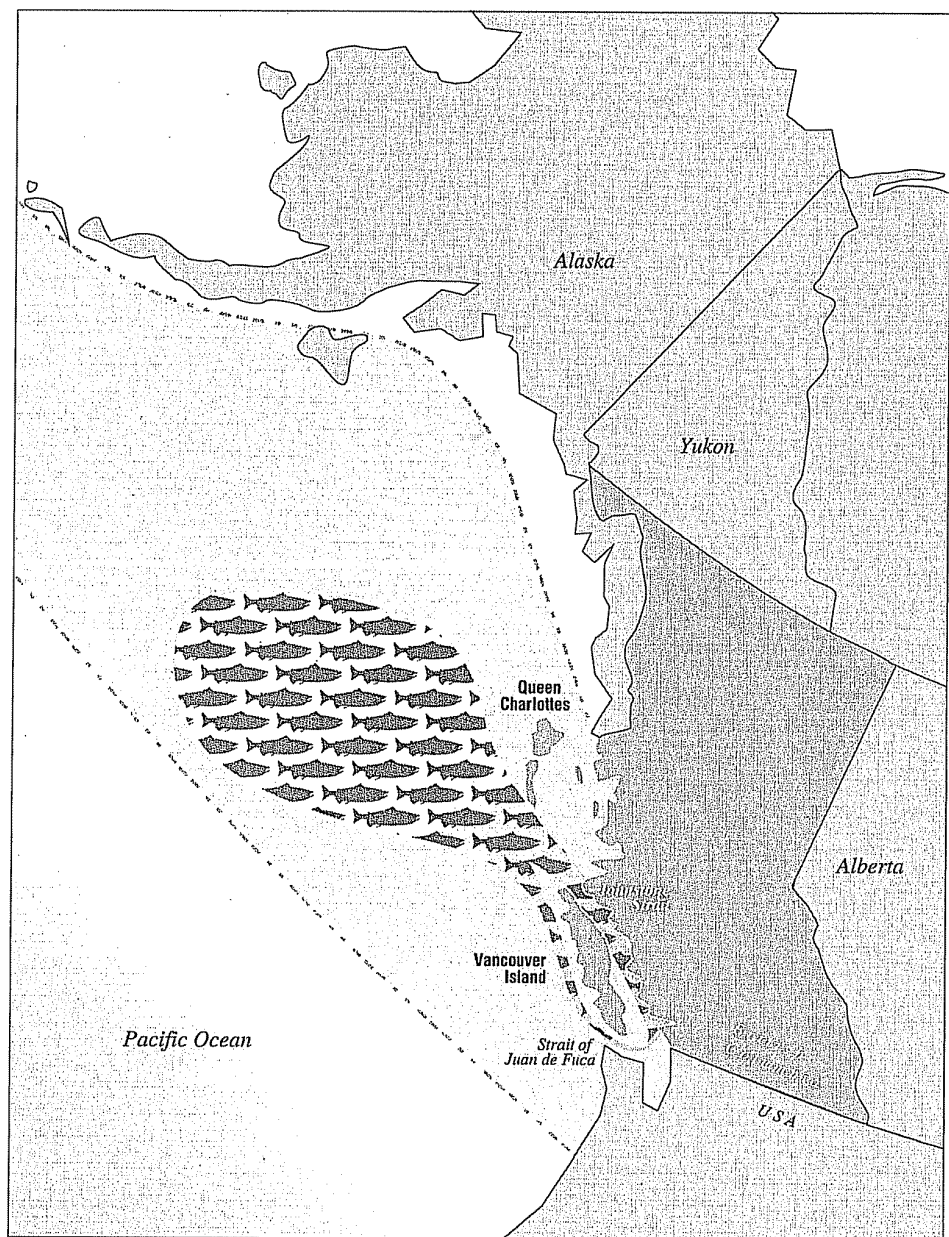
was drafted, but the strong commercial fishing lobby in Washington State opposed the agreement and refused to recognize U.S. federal authority. Canada continued to press for a salmon treaty and received some support, from the unfortunate consequences of the Hells Gate disaster, when 1917 and 1921 stocks were so low. Another

convention was drawn up, but Washington State continued to object to U.S. federal involvement. Following an increased take on the part of Canadian fishers, an agreement was reached in 1930, and in 1937 the International Pacific Salmon Fisheries Commission (IPSFC) was established to regulate sockeye. Pinks were added to the Agreement in 1957.

The current Pacific Salmon Commission (PSC) was formed to implement the Pacific Salmon Treaty of 1985<sup>7</sup> and replace the IPSFC. It is not a regulatory body but does provide regulatory advice to the two signatories. PSC concerns itself with all salmon originating in the waters of one country and are subject to interception by, or might affect the management of, stocks in the other country. The principal function of the Commission is to conserve Pacific salmon to ensure optimum production and to divide the harvests so as to allow each country to benefit from its own investment in management of the salmon resource. Membership comprises representatives from federal, state, provincial and tribal governments and commercial and recreational fisheries from both countries.

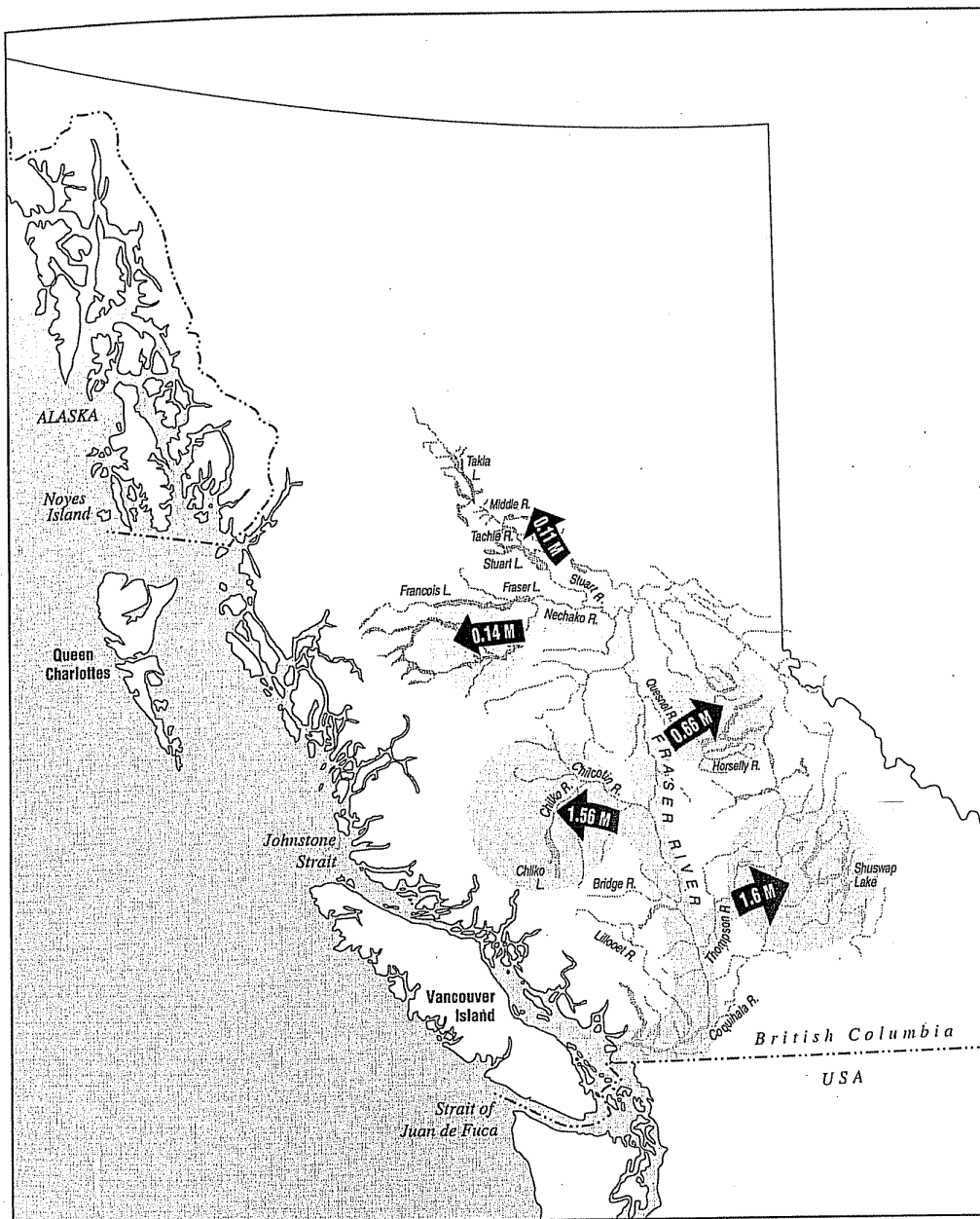
We will address PSC's estimation techniques and management issues later in the Report.

**Figure A**  
**COASTAL MIGRATION**



*Coastal migration routes for the Fraser River sockeye. In 1994, approximately 80 percent of the sockeye migrated through the Johnstone Strait. The lightly shaded marine area shows the approximate outer limit of the historic distribution.*

**Figure B**  
**UP-RIVER MIGRATION**



*Up-river sockeye migration in 1994 including escapement to the major spawning areas.*



## THE 1994 SEASON IN RETROSPECT

January 1993  
*DFO estimates 30 million*

January 1994  
*Estimate downgraded by  
DFO to 19 million*

Pre-season  
*DFO predicted diversion  
rate of 68 percent*

January to July 1994  
*Negotiations under  
Pacific Salmon Treaty:  
agreement not reached*

Spawning escapement to many of the major Fraser tributaries had been good in 1990, and the expectation for 1994 was generally optimistic. An early forecast, based on cycle escapement expectation, had led to a provisional estimate of about 30 million fish. This estimate was later adjusted downward to 19 million after examination of freshwater survival indices, climatic factors and other traditional information influencing run strength. Even so, the 1994 sockeye run was expected to be one of the largest in recent history.

During 1994 warmer than average spring and early summer ocean surface temperatures, attributable to the El Niño phenomena of 1992 and 1993, caused ocean sockeye to move further north into Alaskan waters. Government and academic scientists speculated on the effects of the ocean environment. In previous years under warm ocean conditions the sockeye tended to migrate down a coastal route and the east side of Vancouver Island through Johnstone Strait. In most years, when these conditions did not prevail, the majority of the Fraser River sockeye migrated down the west coast of Vancouver Island, into the Juan de Fuca Strait and eventually into Georgia Strait and the Fraser River. Predictions were that about 68 percent of the 1994 run would divert into Johnstone Strait.

In advance of the 1994 season, Canada-U.S. efforts to reach agreement on allocating the Fraser River salmon harvested under the Treaty had failed. Harvesting of the Fraser stocks thus could not proceed under a united international plan. Canada was left with the task of designing a fishery strategy that would allow Canadian managers to

(1) achieve desired escapement levels, (2) ensure First Nations' food fish requirements were met, (3) allow Canadian fishers to harvest as much of the "surplus" stock as possible, and (4) structure and conduct fisheries in a manner consistent with inter-gear group allocation agreements. Moreover, this was all in the context of an overt strategy to minimize the U.S. share of the Fraser River catch. Thus, the 1994 Canadian fishing plan became known as the "aggressive fishing strategy."

This strategy led Canadian fishers to position themselves to intercept, ahead of U.S. fishers, the sockeye predicted to move south along the west coast of Vancouver Island and into the Juan de Fuca Strait. Because of the expected large diversion of sockeye down Johnstone Strait, stocks on this migration path would be less vulnerable to U.S. interception and thus could be used to meet in-river catch and spawning escapement requirements.

Early signals quickly confirmed that a substantial component of the Early Stuart and Early Summer runs would migrate down Johnstone Strait. They also indicated that these runs were not as strong as anticipated. The Early Stuart run estimate was reduced from 400,000 to 200,000, and the Early Summer run estimate was reduced from 1.1 million to 800,000.

Meanwhile, at the beginning of July, as the Early Stuart and Early Summer runs were migrating up the Fraser River, fishing agreements for the 1994 season had yet to be concluded with the Lower Fraser First Nation communities.

During the Early Stuart and Early Summer migration, near record-high temperatures were being recorded at Hells Gate in the Fraser canyon. These water temperatures were close to 2°C above the long-term average of 15.7°C and on some days approached the lethal range for sockeye (above 21.5°C) in the Nechako and Stuart rivers.

July 28, 1994  
*Minister of Fisheries  
and Oceans announces  
"aggressive fishing strategy"*

During July 1994  
*Canadian commercial fleet  
positions itself along west  
coast of Vancouver Island  
and in the Juan de Fuca  
Strait*

July 16, 1994  
*PSC downgrades Early  
Stuart run estimate*

August 6, 1994  
*PSC downgrades Early  
Summer run estimate*

July 10, 1994  
*Musqueam/Tsawwassen/  
Burrard/Coquitlam  
AFS Agreement signed*

July 21, 1994  
*Sto:lo AFS  
Agreement signed*

Late July 1994  
*DFO reports near record-  
high temperatures in  
the Fraser River*



August 9, 1994  
*DFO field staff provide  
first preliminary estimates  
of Early Stuart spawning  
escapement*

*Estimates of in-season  
Johnstone Strait diversion  
jump to over 90 percent  
between August 5  
and 26, 1994*

August 26, 1994  
*PSC revises estimates of  
Summer run downward*

Late August/early  
September 1994  
*PSC announces upgrades of  
Late run sockeye stocks*

September 2, 1994  
*AFS Agreement reached  
with Kwakiutl Territorial  
Fisheries Commission in the  
Johnstone Strait area*

By the second week of August, Department of Fisheries and Oceans scientists determined that preliminary spawning estimates for the Early Stuart run were only 28,000 to 33,000 as compared to a pre-season target of about 200,000.

As the commercial fishing season progressed, catch and effort data indicated an ever-increasing diversion of sockeye down Johnstone Strait which required Canadian fishery managers to abandon plans to make major interceptions in the southern areas and to recast their fishing plans to the north. The commercial fleet moved from the entrance of Juan de Fuca Strait to more northern areas and into Johnstone Strait.

Fisheries managers were forced to rely on run size estimation techniques which, while reliable in normal years, were not necessarily accurate predictors for the extraordinary 1994 circumstances in Johnstone Strait.

Seine fishing in Johnstone Strait took place over four short periods between August 8 and 31. Data available by late August led to a downgrade of the Summer run size estimate from 10.3 million to 6.8 million.

By early September, the Late run was upgraded from 7.1 million to 9.3 million sockeye, 3 million of which were believed to be off the mouth of the Fraser in Georgia Strait.

Even in the face of an in-season alteration of fishing strategies, the mobility and fishing power of the aggregate fleets were effective in harvesting about 78 percent of the sockeye bound for the Fraser River. U.S. fishers took about one sixth of this harvest. Including the Fraser River First Nations fishery, the 1994 harvest amounted to about 80 percent of the total run.

To this point in the season, estimates of the numbers of fish passing the Mission hydroacoustic station for the Early Stuart, Early Summer and Summer runs were thought to be in line with adjusted in-season targets.

By mid-September, however, DFO announced that spawning escapement estimates plus Aboriginal catch estimates for the Early Stuart, Early Summer and Summer runs were 1.3 million lower than the number of sockeye anticipated, based on PSC estimates at Mission for these runs.

Subsequently, the Minister announced the creation of an independent review board to oversee an examination of discrepancies between the predicted and actual returns of Fraser River sockeye. Four DFO technical working groups were established to investigate aspects of the situation.

The confusion and concern over missing fish were further exacerbated when PSC announced a revision of its estimate of the Adams River and other Late run sockeye on September 30, 1994. The new escapement figure was unlikely to exceed 1.5 million fish, which was approximately half the earlier in-season estimate. The Minister responded by expanding the mandate and membership of the review Board.

By season's end a myriad of claims and counter claims erupted, blaming illegal fishing, bad management, out-dated technology and environmental disaster for the "missing fish" and poor escapement. There were abundant theories about who was to blame. The perceived credibility of the various management agencies was seriously challenged.

September 4, 1994

*Both U.S. and Canadian commercial fisheries were closed by this date, having met their seasonal allocation*

September 15, 1994

*Press release from the Hon. Brian Tobin states that he is "dismayed by the apparent discrepancies"*

September 26, 1994

*Minister's office announces that an independent review board "will review the progress of a management team set up to investigate the salmon shortfall"*

September 30, 1994

*PSC announces Adams River and other Late runs unlikely to exceed 1.5 million fish, half of the in-season estimate*

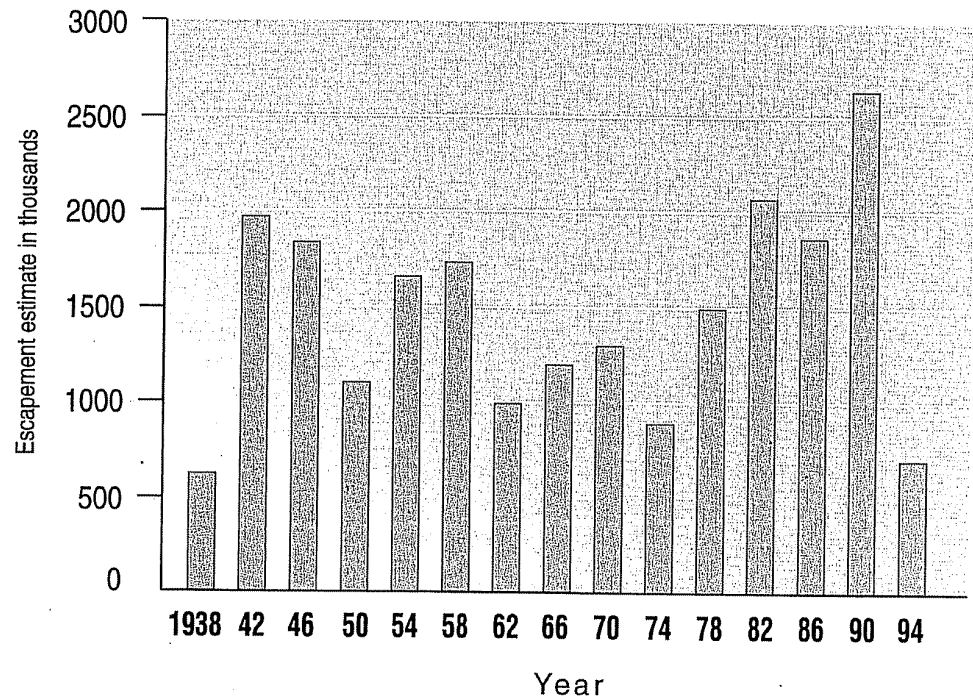
October 3, 1994

*The Minister announces extension of the independent review board's terms of reference to include an examination of the Pacific Salmon*

January 24, 1995

*DFO completes near final spawning escapement estimates for Late run stocks showing Adams River escapements set back to pre-1940 levels*

**Figure C**  
**ADAMS RIVER SPAWNING ESTIMATES**  
**(1938-1994)**



This is obviously not the first time that conservation of the salmon has been of concern. There have been several episodes in the past which led to government investigations and reports. In fact, only two years ago, Dr. Peter Pearse was commissioned to investigate a similar problem.<sup>8</sup> What is it about our review that sets it apart from the others?

As we see it, three sets of considerations underscore the timeliness and uniqueness of this 1994 review.

First, the resource is now, more than ever before, critically endangered. Investigations have been made in the past and reports submitted<sup>9</sup> but we wonder to what extent their recommendations were actually taken seriously. In salmon management, regulatory authorities and other stakeholders cannot pick and choose the recommendations they believe would be easiest to implement. The consequences of inaction can be severe. We will be reviewing what might have contributed to the 1994 situation and making recommendations for preventing the same thing from happening in the future. If something is not done now, soon there will no longer be any reason to conduct reviews. Now is the time to realign the game pieces and establish relationships among the players to make the system workable.

## *Introduction*

The general thrust of many of the recommendations from previous reports was to improve surveillance, monitoring and enforcement and to have a clearer fisheries management program. We must ask ourselves, therefore, why were the number of Fishery Officers reduced, or why it was that in 1994 the fishery was characterized to us by many observers as being out of control?

Second, though Dr. Pearse commented on the Aboriginal Fisheries Strategy, this policy was only in its early stages in 1992. Since then, several factors have arisen as the policy has taken hold which merit discussion and action.

Third, in the last two years downsizing in the federal government has continued with a consequent restructuring in the Department of Fisheries and Oceans dramatically affecting the regulatory and enforcement situation in the fisheries.

As we will demonstrate, these factors have contributed to today's situation.

## NOTES

1. Chinook, coho, pink, chum, sockeye and, to a lesser extent, steelhead.
2. Cornelis Groot and Leo Margolis, eds., *Pacific Salmon Life Histories*. Vancouver: UBC Press, 1991; Mark Hume, *Adam's River: The Mystery of the Adams River Sockeye*. Photography by Rick Blacklaws. Vancouver: New Star Books, 1994.
3. Each female sockeye lays about 3,500 eggs in the gravel. Following fertilization and hatching after a six- to seven-month incubation period, alevins emerge from the gravel. About 10 percent survive to the fry stage. The fry feed and grow in a nearby lake for a year. About 25 percent of those fry survive to become seaward-migrating smolts. On average, about 10 percent of the smolts survive to be adults. This represents about nine fish for 3,500 original eggs. (Cornelis Groot and Leo Margolis, eds. *Pacific Salmon Life Histories*. Vancouver: UBC Press, 1991.)
4. Combined harvest rates for the 1994 season were approximately 80 percent of the total run size.
5. The slide dumped about 100,000 cubic yards of rock into the Hells Gate canyon.
6. G.A. Rounsefell and G.B. Kelez. "The Salmon and Salmon Fisheries of Swiftsure Bank, Puget Sound, and the Fraser River." *Bulletin of the Bureau of Fisheries*, Vol. XLIX, No. 27 (1938): 693-823.
7. *Pacific Salmon Treaty*, March 17, 1985. Treaty between the government of the United States of America and the government of Canada concerning pacific salmon.
8. Peter H. Pearse, *Managing Salmon in the Fraser: Report to the Minister of Fisheries and Oceans on the Fraser River Salmon Investigation*. Ottawa: DFO, 1992. The problems and observations of 1992, in various shades and nuances, characterize the 1994 scenario, except that our mandate extends well beyond in-river issues.
9. Between 1980 and the Pearse and Larkin report of 1992 there were three studies of significance to this review:
  - a) *Compliance Analysis of the B.C. Fishery* by D.J. Clough (1980) which recommended measures to improve the efficiency and effectiveness of DFO's surveillance, monitoring and enforcement. This report formulated an enforcement strategy based on risk/consequence analysis;
  - b) *An Evaluation of the Surveillance and Enforcement of the Pacific Region, Department of Fisheries and Oceans* by E.W. Willes (1982) which recommended measures to improve the structure, policies and procedures for achieving effective administration of DFO's enforcement. A highlight was the suggestion that an enforcement directorate be established; and
  - c) *Turning the Tide: A New Policy for Canada's Pacific Fisheries: The Commission on Pacific Fisheries Policy, final report* by Dr. Peter Pearse (1982) which made

## *Introduction*

recommendations aimed at correcting "fundamental deficiencies in fisheries policy." Dr. Pearse recommended means for reorganizing the commercial fisheries, for preserving and enhancing recreational fishing and for securing traditional Aboriginal access to fish. The report dealt with such disparate matters as fisheries resource management and conservation, industrial regulation, recreational fishing policy, Aboriginal rights, environmental protection, intergovernmental arrangements, administration, enforcement and research. Recommendations on enforcement included measures to improve policy, structure (i.e., an enforcement directorate), administration, penalties and sanctions.

# 2

## *The Board's Mandate*

This chapter has been prepared in response to the six specific terms of reference in the Board's mandate. Major sections of the chapter, which parallel the order and topical subjects of the mandate, address the underlying concerns of the government and the public. Our efforts were greatly facilitated by the four Department of Fisheries and Oceans (DFO) technical reports prepared with assistance of scientists from the Pacific Salmon Commission (PSC) and elsewhere. These reports, listed below, are public documents:

*Report of the Mission Hydroacoustic Facility Working Group*

*Report of the In-River Catch Estimation Working Group*

*Report of the En-route Mortality Group*

*Report of the Spawning Escapement Estimation Working Group*

We explore aspects of each of these reports throughout this chapter and provide some commentary with respect to ongoing estimation programs (see Technical Appendices).

Many individuals who were convinced of a large unreported catch above Mission felt that their concerns were going unrecognized. They seized upon the fact that the sum of the up-river estimates (in-river catch plus spawning escapement) for the Early Stuart, Early Summer and Summer runs fell short in-season by 1.3 million fish from the number estimated to have passed Mission. Claims that this discrepancy proved the existence of illegal fishing were countered by other claims of severe biases in the Mission hydroacoustic estimates and later reports of significant in-river mortality.

The original purpose of the collection of estimates has largely been forgotten. The estimation system was initially designed to provide information for managing a fishery that contained, by today's standards, two simple components: a commercial fishery focussed primarily in the vicinity of the river mouth, and a small, up-river Aboriginal fishery. The overall management scheme, including the estimates, performed reasonably well during this earlier period of generally steady stock rebuilding.

These estimates, however, were not designed to provide a detailed public accounting of the extent of poaching and/or under-reporting of catch. Nevertheless, there is more than enough evidence to conclude that a general breakdown of enforcement occurred during 1994 leading to increased unreliability in catch estimates. We have concluded that, in conjunction with uncertainty regarding in-river catch levels and en-route mortality, the estimates are too prone to errors to be very useful for this purpose. Nevertheless, in 1994, the estimates point strongly to a large unreported catch of the Early Stuart run. In the later runs, the margin for error in these estimates was large enough to mask an unreported catch of up to several hundred thousand fish.

Figure D summarizes our interpretation of the estimates and possible associated errors. In the following pages we provide a more detailed account of the estimation methods in our discussion of the Mission and up-river estimates (see Technical Appendices).

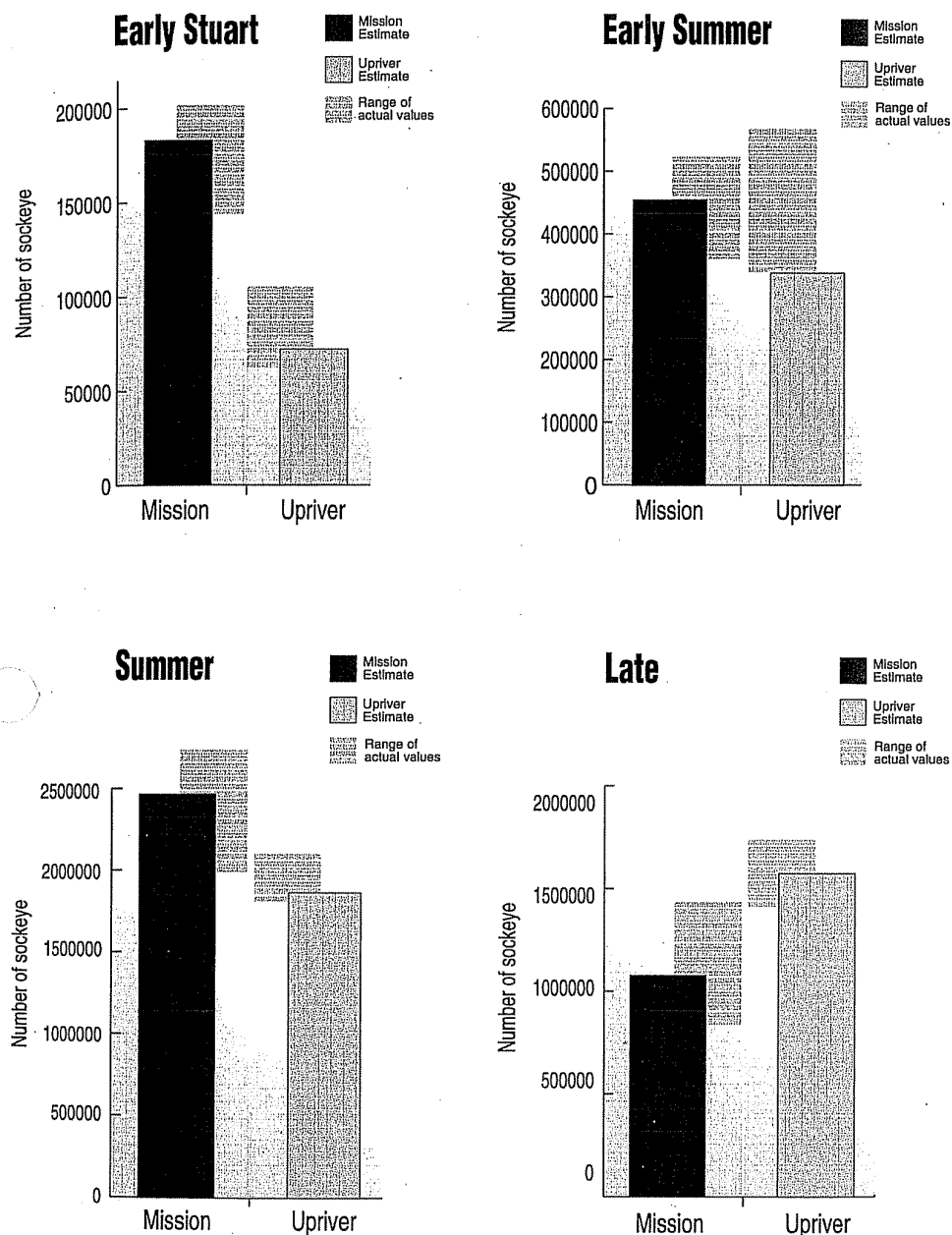
Although these estimates are not adequate for a detailed accounting among the various in-river mortality factors, they are frequently used for this purpose. We are convinced that these estimates, along with in-season estimates of catch, run size and run timing (discussed elsewhere in this chapter) have at times been used to make management choices without consideration of the underlying risks involved. Changes to both the traditional commercial and Aboriginal components of the fishery may have pushed the management system beyond its current limits. These changes include the following:

1. Increased capacity, efficiency and mobility of the commercial fleet;
2. Increased complexity in the structure of the Aboriginal fishery;
3. Increasingly more detailed allocation targets in both the commercial and Aboriginal components;
4. Unprecedented diversion of returning sockeye from the more commonly used route through the Juan de Fuca Strait to Johnstone Strait; and
5. Unfavourable in-river environmental conditions.

To meet detailed allocation targets in the coastal sector, managers are under intense pressure to create late season catch-up and compensatory fisheries. This in turn creates pressure to downplay potential estimation errors. When too few fish are allowed to escape to Mission, DFO faces a dilemma in meeting both its constitutional obligations to up-river Aboriginal groups and its conservation goals.



**Figure D**  
**MISSION VS. UP-RIVER ESTIMATES FOR THE FOUR MAJOR RUNS**



Mission versus up-river estimates for the four major runs. The estimates are subject to errors whose sizes cannot be precisely determined. The bars labelled "range of actual values" show the range of actual number of fish that might have passed Mission versus the number accounted for in up-river catch, en-route mortality and spawning escapement.

## **PART I**

### **HYDROACOUSTIC FACILITY AT MISSION**

*The review will include consideration of the following ... (1) The accuracy of estimates of the number of sockeye salmon moving past the PSC's hydroacoustic facility at Mission in 1994. This aspect of the review will examine the accuracy separately for each of the four major run components: Early Stuart, Early Summer, Summer and Late Summer. It will include an evaluation of the actual acoustic procedures and the analytical methods used to prepare estimates from acoustic data.*

From the Terms of Reference for the Fraser River Sockeye Public Review Board

The first report produced internally by DFO to which we turned our attention was the *Report of the Mission Hydroacoustic Facility Working Group*.

Echo sounders have been used since the 1930s as a method to locate fish stocks in ocean fisheries. Acoustic techniques were given much wider application after World War II and used to study such matters as fish migration, general fish behaviour, schooling phenomena and stock enumeration. Technological advancements since the late 1960s have led to the introduction of new sonar devices such as acoustic cameras. The greatest limitation to acoustic enumeration techniques, however, continues to be their inability to differentiate between species and, at times, between fish and debris.

Using such technology, the Mission hydroacoustic facility was established by the International Pacific Salmon Fisheries Commission in 1977 to estimate the number of salmon entering the Fraser. The site was selected because of its location at the lower end of the Fraser watershed where the physical characteristics of the river bed and other logistic factors made it ideal for hydroacoustic measurement. As previously noted, it was established as a technique to estimate fish passage, not to enumerate potential missing fish.

The historical relationship of Mission and up-river estimates has been used extensively to compare the number of salmon arriving in the lower river with in-river catches and spawning escapement. Up to 1991, this relationship remained reasonably reliable. Since that time, the discrepancy between Mission counts and up-river catch plus spawning escapement estimates has deteriorated and has thus been the subject of considerable debate.

The Mission facility uses a boat-mounted echo sounder to collect two types of measurements in the river. The boat traverses the river about 215 times each day to measure the density of passing fish. As well, stationary soundings are taken nine times daily to gather information on the average travel speed of fish. Both types of data are fed into a mathematical formula to estimate the number of fish passing.

Mission estimates are subject to inherent and as yet unquantifiable biases. A description of the major sources of bias is provided in Technical Appendix 1, and we believe that the following can be said:

1. Positive biases result in overestimation of fish in the river, the magnitude of which could be in the range of 20 percent or higher; and
2. Negative biases are also present which lead to an underestimation.

The present inability to measure and correct for biases points to the need for a policy of continuous assessment and upgrading of methods.

## **ESTIMATES OF IN-RIVER CATCH**

*The review will include consideration of the following areas ... (2) The accuracy of estimates of the catch of sockeye salmon in the Fraser River in 1994. This aspect of the evaluation will include an examination of the reliability of the in-river catch monitoring program, techniques used to estimate catches, and procedures for estimating the confidence range around the catch estimates.*

From the Terms of Reference for the Fraser River Sockeye Public Review Board

Accurate catch estimates are needed for fish management, although the task of collecting accurate and timely catch data can often be difficult. Successful programs of this type require active co-operation from the vast majority of participants. Simply establishing such a program will not guarantee a timely flow of accurate information. An effective and visible enforcement mechanism is required to create the incentive necessary to ensure full co-operation.

Given information from numerous intervenors, we agree with the In-River Catch Estimation Working Group that the reliability of reported catch estimates cannot be verified. Furthermore, because of reductions in DFO enforcement staff, there are simply not enough officers in place to estimate the magnitude of the illegal catch.

The Working Group report notes that the numbers of charges and seizures during 1994 patrols do not appear to indicate an uncontrolled poaching problem. The Board cautions, however, that evidence will not be found if no resources are assigned to search for it.

The methodology used by the Working Group to estimate the unreported legal catch is essentially sound and based on whatever information was available to them. Among other things, however, the methodology could not adequately address the implications of potential pooling of catches. It is the very nature of the available

information in 1994, however, that limits the accuracy and precision of the revised catch estimate. For example, although DFO is well aware that the majority of fishing occurs at night in the upper Fraser, patrol personnel were assigned only four evenings during the entire season. This and related problems reflect the need to adapt institutional arrangements to secure accurate information.

The report also cites examples of commendable recent improvements to catch estimation procedures. Co-operative arrangements with several First Nations have addressed such issues in the context of co-management in their territories. Such arrangements form a solid basis for a workable agreement, and DFO should continue to pursue such opportunities.

However, despite the best intent, if the same personnel — whether Aboriginal or DFO — are in place to perform the dual functions of monitoring and enforcement, a tradeoff is created. Enforcement officers and catch monitors perform complementary tasks, and sufficient numbers of both are required to minimize illegal fishing and to obtain the accurate catch estimates necessary to manage the fishery.

The Working Group report contains much valuable discussion of the existing catch estimation programs and possible improvements. In Technical Appendix 2 we outline recommendations which the Board believes would be most important in providing a reliable set of in-river catch estimates.

## ESTIMATES OF IN-RIVER MORTALITY

*The review will include consideration of the following areas ... (3) The level of mortality experienced by sockeye salmon in the Fraser River and on the spawning grounds in 1994. Temperatures throughout the Fraser River were at all time high throughout the period from mid July to mid August 1994. The evaluation will examine the effect of these temperatures, in conjunction with average flow conditions experienced in 1994 and other relevant factors, on the level of mortality experienced by sockeye salmon while en route to the spawning grounds. This evaluation will also identify causes of elevated water temperatures in the Fraser River, including forestry practices.*

From the Terms of Reference for the Fraser River Sockeye Public Review Board

As we have noted, Fraser River sockeye experience multiple stresses in their return migration to the spawning grounds. The question we had to ask ourselves was whether such stresses could have been severe enough in 1994 to cause the death of almost half a million fish as estimated in the report of the DFO En-route Mortality Working Group. Technical Appendix 3 summarizes the report of this Working Group.

Adult sockeye migrating through fresh water swim most efficiently at temperatures around 15°C. Being cold-blooded, their body temperature is close to the temperature of surrounding water. If too cold, their metabolism may slow, and if too hot, physiological processes speed up, and valuable energy may be wasted. Water temperatures over 21.5°C are usually lethal. Typically, temperature stress is not a serious

*We have temperatures, daily temperatures on the order of 22 or more degrees. That is extremely, extremely bad news if you're a sockeye.*

Dr. Mike Henderson, Stock Assessment  
Division, Department of Fisheries and Oceans,  
November 23, 1994 (Vancouver)

problem for the Early Stuart run. By August, however, temperatures at Hells Gate and in many of the key Fraser River tributaries often exceed 15°C.

Sockeye with insufficient energy reserves will die en route. Those encountering both fast waters and temperatures at the upper end of their tolerance are particularly vulnerable, especially if they are

returning to the most distant spawning areas such as the Stuart and Nechako rivers. Additional stresses will arise for sockeye swimming through contaminated water such as that proximate to the sewage treatment facility at Annacis Island. Although the precise effects of such stresses are unknown, it is recognized that they can delay the sockeye's migration, deplete their energy reserves or render them more susceptible to subsequent stresses such as encounters with nets, especially those made of monofilament line.

The following facts can be associated with the 1994 Fraser River sockeye run:

1. During Early Stuart run migration in mid-July, water temperatures at Hells Gate rose sharply to near record highs of 17.7°C and, in the Nechako and Stuart rivers, on some days approached the lethal range for sockeye. Some observers relate these high water temperatures to the large discrepancy in the numbers of sockeye from this run estimated to have passed Mission (181,000) and to have been caught up-river or made it to the spawning ground (64,000). Although 1994 was an unusually warm year for the Early Stuart run, river levels in the Fraser canyon were not unusually high. Hence, while the fish were subject to high energy demands, the sockeye had been exposed to more adverse conditions in other years.
2. River temperatures remained high, though not at record levels, throughout the month of August. The high temperatures were mitigated to some extent by essentially normal river levels and water flows.

3. Radio-tracking studies in the Fraser canyon indicated unusual fish behaviour, such as sluggish movement and, in addition, could not account for a number of radio-tagged fish.
4. Sockeye carcasses were noted to be slightly more numerous in 1994 than in other years, but not to the same degree as in previous years of high mortality such as 1982.
5. Environment Canada monitoring indicated that there was no evidence of any unusual levels of sewage effluent or industrial pollution in the Fraser River basin in 1994.
6. There was no marked increase reported in prespawning mortality on the spawning grounds.

Knowledge of the causes and magnitude of en-route mortality is important to proper management. Unfortunately, there is insufficient evidence to make reliable estimates of the numbers of fish that died in the Fraser River in 1994, or any other year. The estimate of 15 percent mortality proposed by the Working Group is merely an educated guess, largely based on an extrapolation from Dr. Peter Larkin's 1992 mortality estimate of 10 percent.<sup>1</sup> Larkin's estimate, perhaps adequate at the time, should not be the foundation for subsequent estimates. Furthermore, the Working Group estimate is likely overstated in that it fails to adjust for fish caught in the river above Mission.

The 1994 experience highlights the need to formulate a contingency plan to deal with in-season observations of high water temperatures. For runs facing unusually high energy demands, the spawning escapement target should be raised. Radio-tagging studies, bioenergetic modelling and the Qualark Creek fish enumeration facility, which have produced valuable preliminary results, should continue in order to support efforts to quantify in-river mortality.

## ESTIMATES OF SPAWNING ESCAPEMENT

*The review will include consideration of the following areas ... (4) The accuracy of estimates of the number of sockeye salmon on the spawning grounds in 1994. This aspect of the evaluation will include a review of the various techniques used to enumerate sockeye salmon on the spawning grounds, the timing of arrival of the sockeye salmon on the spawning grounds, and the rates of tagging and tag recovery for those stocks enumerated through mark-recapture programs. As required, information from other years will be used in this assessment.*

From the Terms of Reference for the Fraser River Sockeye Public Review Board

Approximately 100 Fraser River sockeye spawning ground surveys are conducted each year. Although some sites are accessible, others are more remote. The number of spawners to be estimated varies greatly from creek to creek.

DFO uses several spawning ground estimation techniques. For large returns, mark-recapture techniques are best suited. On selected streams, a census of the entire sockeye population is attempted via enumeration fences or visual counts in artificial spawning channels. The remainder are assessed through visual surveys. Technical Appendix 4 describes and evaluates these techniques in more detail.

Although the Board recognizes the benefits of consistent estimation methodology in building a reliable data base, a balance must be struck between that continuity and the need to be flexible. Such flexibility might entail either updating methods or using methods more suited to the changing population on spawning grounds. Different methodologies can produce markedly different estimates of population, which may reflect an actual change or merely be a product of the change in methodology. For example, in 1994, three spawning populations were estimated by both mark-recapture and visual surveys. Table 2.1 points out the major variations possible in using these two techniques.

**Table 2.1**  
**COMPARISON OF MARK-RECAPTURE AND VISUAL SPAWNER**  
**STOCK ESTIMATES IN 1994**

Stock	Estimate		
	Mark-Recapture	Visual	% Difference
Mitchell River	198,500	88,300	125
Middle River	29,900	4,500	564
Tachie River	41,400	12,800	223

Estimates of spawning escapement are subject to both chance errors and biases. The most accurate estimators of spawning populations tend to be fence enumeration and visual spawning channel counts. Of the others, mark-recapture estimates tend to be subject to positive bias and visual estimates to large negative bias. Given the potential biases (demonstrated in Table 2.1) in visual survey methods, the Board believes that this technique requires a thorough reassessment, with particular focus on the correction factors employed.

Although Technical Appendix 4 details procedures for, and biases in, the various estimation techniques, it is useful to make some observations at this point.

The Early Stuart run is estimated primarily by visual counts and, to a lesser extent, by fence enumerations. Overall, these methodologies could underestimate spawning population for this run by 10 percent or more.

The Early Summer run, comprised primarily of small stocks and enumerated mainly through visual surveys could have been subject to negative bias of more than 50 percent. If realized, this bias could account for up to 170,000 of the so-called "missing" fish.

The Summer run stocks are estimated essentially using the mark-recapture technique, and it is likely that a relatively small positive bias occurred. Chance errors associated with this technique may well be larger, but with high statistical probability, it

is possible to conclude that these errors would account for no more than 10 percent of the fish thought to have been missing from this run.

The Late run, which includes the Adams River run, is similarly assessed in large part by a mark-recapture program. One can expect a small positive bias in the spawning escapement estimates for this run.

Given the various techniques available and the inherent biases in each, the Board believes that DFO should develop a compre-

hensive plan for estimating spawning escapement. Such a plan should be updated annually to reflect any relevant changes in methodology, fish populations and environmental factors. To facilitate regular review by outside experts, the plan and all procedural information should be formally documented and publicly accessible.

## CONCLUSION

The Board recognizes that observation of the relationship among these various estimates over time may aid both scientists and fisheries managers in searching for ranges and patterns in the data. We provide such an assessment in Technical Appendix 5. In the absence of a clearer understanding of the sources for error in each of the three estimates (Mission, in-river catch and spawning escapement), and in the absence of any defensible estimate of in-river mortality, definitive conclusions about the cause of a discrepancy cannot be made.

*The linchpin of fisheries management is knowing how many fish you caught, because if you don't know how many fish you get, you don't know whether the area should be open and you don't know whether to close it. You're right. Whether it's a food fishery or a commercial fishery, it is critical to know how many fish are being caught.*

Mr. Phil Eidsvik, B.C. Fisheries Survival Coalition,  
November 29, 1994, Vancouver



## **PART II**

### **PACIFIC SALMON COMMISSION AND ITS METHODOLOGY**

*The review will include consideration of the following areas ... (5) In consultation with the PSC, examine the methods used by the Commission to predict returning run strength and escapement, both pre-season and in-season. This aspect will include an assessment of the accuracy and dependability of the estimation methods, including the Mission hydroacoustic facility, PSC-contracted test fisheries, and estimates of catch and removal rates in Johnstone Strait, Juan de Fuca Strait and North Puget Sound fisheries.*

From the Terms of Reference for the Fraser River Sockeye Public Review Board

We have alluded to the role of the Pacific Salmon Commission (PSC) in our examination of the history of salmon management. We now turn to an examination of the methods used by PSC to predict returning run strength and escapement.

Many of the salmon stocks which spawn in the Fraser River pass through U.S. waters during their migration to the spawning grounds and are susceptible to interception by U.S. fishers. In an attempt to streamline difficult management issues created by the migratory patterns of various salmon stocks, Canada and the United States entered into the Pacific Salmon Treaty in 1985.

PSC was formed pursuant to the Treaty. The Commission does not regulate the salmon fishery itself, but provides regulatory advice to the two signatory countries for all salmon stocks which originate in one country and are susceptible to interception by the other country. The stated goals of PSC are to conserve the Pacific salmon in order to prevent overfishing and provide for optimum production and to provide for each party to receive benefits equivalent to the production of salmon originating in its waters.

#### **The Fraser River Panel**

In years when Canada and the United States reach a fish sharing agreement under the Treaty, PSC's Fraser River Panel is responsible for making an annual proposal to the Commission of fishing plans for the harvest of salmon. Such plans are intended to achieve gross escapement into the Fraser River and domestic allocation objectives for each country's user groups and to meet requirements with respect to the management of stocks other than Fraser sockeye and pink salmon.<sup>2</sup> The Commission then recommends to the parties that they enact regulations to give force to the proposed fishing plans. In-season, the Panel is authorized to make orders to adjust fishing times and areas stipulated in annual regulations for the waters within its jurisdiction.

The Fraser River Panel comprises Canadian and U.S. agency representatives plus representatives of various user groups including the commercial, recreational and

Aboriginal fisheries. The Panel meets not less than weekly throughout the fishing season, and frequently more often if updated technical information from PSC staff warrants.

In 1994, the management scheme was complicated by the lack of an agreement between Canada and the United States under the Treaty. The Canadian and American sections of the Panel met independently of each other to determine fishing strategies. The Canadian section of the Panel continued to receive technical information

*In 1994 we had no responsibility to deliver any fish to Mission ... we had a responsibility only to assess the incoming run strength, the diversion rate and the timing. And based upon the assessments that we provided to the two countries through the medium of the independent domestic management agencies, they established the fishing patterns that would then meet whatever goals they set.*

Mr. Ian Todd, Executive Secretary, Pacific Salmon Commission, November 23, 1994, Vancouver

relating to abundance and timing estimates from PSC technical staff and continued to advise DFO on commercial fishing management of Fraser River sockeye within the Panel's area of responsibility.

The lack of an agreement under the Treaty resulted in a policy decision by the Minister of Fisheries and Oceans to pursue an "aggressive fishing strategy." This strategy, announced on July 28, 1994, was aimed at encouraging Canadian fishers to harvest as aggressively as possible on the west coast of Vancouver Island and in Juan de Fuca Strait before the Fraser River sockeye became vulnerable to American interception closer to the mouth of the Fraser River. Ultimately, this strategy was largely unnecessary because of the high diversion rate of sockeye salmon through Johnstone Strait rather than down the west coast of Vancouver Island. The strategy did, however, contribute to a "grab all" attitude in the Canadian commercial fleet, and a corresponding removal of any moral responsibility for conservation on the U.S. side. This unpleasant situation was fraught with peril.

### **Methods Used by the Commission to Predict Run Strength**

The process of forecasting run strength and escapement is shared between PSC and DFO. Early in the four-year cycle, DFO generates preliminary estimates based on cyclical abundance trends and the number of spawners in the initial brood year.

This pre-season forecast is reviewed and may be modified early in the year for a particular cycle. The review incorporates information regarding freshwater survival and potential environmental factors that may have influenced sockeye survival during their

freshwater and marine life stages. In 1994 the final pre-season forecast was 19 million fish, an estimate made before any actual sampling of the returning run.

As the salmon move onshore during homeward migration, PSC staff assume responsibility for in-season estimates. The initial indicators of run timing, strength and stock composition come from a variety of catch sampling and test fisheries conducted primarily on the west coast of Vancouver Island and the Queen Charlottes. Throughout the season, PSC continues to receive information from a variety of sources including further test fisheries, DFO "hail" catch estimates, DFO catch landings information and estimates of escapement into the Fraser River from the Mission hydro-acoustic station. From this information PSC calculates estimates of sockeye run size and timing. This process continues throughout the season in an iterative procedure that incorporates new information on catch, and estimates of the total run size and stock strengths continue to be adjusted. At the same time, estimates are developed on the diversion rate of sockeye migrating through Johnstone Strait rather than down the west coast of Vancouver Island.

Following the season, information is reviewed and post-season estimates of run sizes are calculated. Pre-season, in-season and post-season estimates from 1985 on are displayed in the table below.

**Table 2.2**  
**FRASER RIVER SOCKEYE FORECASTS AND RUN SIZE ESTIMATES**  
(All numbers rounded to nearest 100,000)

	Long-Term Projection	Pre-Season Forecast	In-Season Estimate <sup>c</sup>	Post-Season Accounting
1985	9,000,000 <sup>a</sup>	9,000,000	13,800,000	13,900,000
1986	18,000,000 <sup>a</sup>	14,100,000	16,700,000	15,900,000
1987	5,000,000 <sup>a</sup>	6,200,000	7,500,000	7,700,000
1988	5,000,000 <sup>a</sup>	2,900,000	3,700,000	3,800,000
1989	10,000,000 <sup>a</sup>	13,000,000	18,100,000	18,600,000
1990	19,000,000 <sup>a</sup>	16,500,000	21,300,000	22,000,000
1991	*	14,500,000	12,700,000	12,400,000 <sup>(P)</sup>
1992	*	5,900,000	6,100,000	6,400,000 <sup>(P)</sup>
1993	17,400,000 <sup>b</sup>	17,400,000	22,700,000	24,300,000 <sup>(P)</sup>
1994	29,600,000 <sup>a</sup>	19,000,000	17,500,000	16,522,000 <sup>(P)</sup>
1995	21,000,000 <sup>a</sup>	n/a		

\* Not known

<sup>a</sup> Projections used for Pacific Salmon Treaty allocation negotiations (December 1984)

<sup>b</sup> Provided to the Pacific Salmon Commission by Canada (February 1993)

<sup>c</sup> PSC estimate obtained from cumulative catch and escapement estimates at the end of the season

<sup>P</sup> Preliminary

In 1994, environmental factors contributed to a large diversion of the Summer and Late runs through Johnstone Strait. An unprecedented eastern shift in the migration route bypassed a test fishery near the north end of Vancouver Island. Even though PSC staff incorporate all available catch data when generating their predictions, their models for Johnstone Strait are, by necessity, heavily dependent upon the large catches from two or three seine openings. This situation, coupled with unprecedented numbers of Late run sockeye migrating through the Johnstone Strait, created difficulty in achieving accuracy in the 1994 stock estimates.<sup>3</sup> The factors responsible for the Late

stock overestimate are currently under debate and are likely to remain speculative for many years.

The 1994 Late run estimates were vulnerable to a large number of factors. The Board heard numerous allegations about the nature and magnitude of illegal fishing in the marine areas and about the laundering of fish into the commercial catch. These are two of many factors that are being considered.<sup>4</sup>

In light of the many sources of uncertainty affecting the 1994 run size estimates, managers relied too heavily on the quality of in-season estimates in making decisions regarding the commercial fishery in Johnstone Strait. It would seem that the findings of the November 1993 PSC workshop on problems and uncertainties confronting

1993 management should have served as a warning in 1994.<sup>5</sup> The workshop report noted that, in 1993, regression models of abundance in Johnstone Strait were stretched beyond their limits. The Board feels that the same was likely true in 1994.

*And there [are many] ways of laundering [the fish]. You could deliver it to an unscrupulous buyer who will give you a fish slip with any kind of area or date you want to put on it. You could take a certain amount of that sockeye and deliver it to a band as food fish and leave the rest in the fish hold and deliver it during the commercial catch. You can deliver fish to a packer as food fish, you can put it aboard a tender — and we have seen that happen — and it is food fish. It is designated food fish until it is sold, and it is not supposed to be sold. People take it to a plant — there are some plants on the river here that just deal in food fish — and have it processed as food fish.*

Mr. John Lenic, Vice President, Fishing Vessel Owners' Association of B.C., December 12, 1994, Victoria

*The apparent inaccuracy of run size estimates in 1993 was associated with a number of the features of the migration and fisheries. The bimodal distribution of the run, the high proportion of the run migrating through Johnstone Strait, removals in seaward fisheries and changes to fishing patterns in Areas 11-13 all had effects on estimates generated by the purse seine catch and CPUE models ... many of [these] events portend continued problems, particularly during periods of high Johnstone Strait diversion, unless the models and/or the fisheries are modified in some way. [emphasis added]*

Pacific Salmon Commission memorandum dated  
January 27, 1994 regarding the November 1993 workshop.

## **DFO MANAGEMENT, MONITORING, SURVEILLANCE AND ENFORCEMENT**

*The review will include consideration of the following areas... (6) The level and efficacy of DFO stock management, surveillance, monitoring and enforcement activities in the Fraser River and elsewhere where relevant. This aspect will include an evaluation of these issues: strategies implemented; performance indicators; resources allocated and expended in the fisheries in 1994, including a comparison with previous years; data collection methods in the commercial, sport and aboriginal fisheries; and the estimated magnitude of undetected illegal catches.*

From the Terms of Reference for the Fraser River Sockeye Public Review Board

To consider the level and efficacy of Department of Fisheries and Oceans' (DFO) management, monitoring, surveillance and enforcement in the Fraser River and elsewhere, it is first necessary to have an understanding of the Department's essential responsibility and authority in connection with the salmon fishery.

Under section 91(12) of the *Constitution Act, 1867* the federal government has jurisdiction over "sea coast and inland fisheries." This jurisdiction is exercised by DFO which is established under the *Department of Fisheries and Oceans Act*<sup>6</sup> and which manages and controls fisheries through the provisions of the *Fisheries Act*<sup>7</sup> and associated regulations.

Responsibility for and authority over "sea coast and inland fisheries" is the basis for DFO's often expressed primary objective to conserve the salmon resource by ensuring that enough fish of each species reach the spawning grounds to ensure the population can at least be maintained, if not enhanced.

*Federal power in relation to fisheries ... is concerned with the protection and preservation of fisheries as a public resource, concerned to monitor or regulate undue or injurious exploitation, regardless of who the owner may be, and even in suppression of an owner's right of utilization.*

*Interprovincial Co-operatives Ltd. v. The Queen,*  
[1976] 1 S.C.R. 477 at 495, Chief Justice Laskin

Fish not needed for spawning are to be allocated to various competing user groups. Of the user groups, Aboriginal food, ceremonial and social fisheries have priority by virtue of section 35(1) of the *Constitution Act, 1982* (the *Canadian Charter of Rights and Freedoms*) as interpreted by the Supreme Court of Canada in *Regina v. Sparrow*.<sup>8</sup> Commercial and recreational fisheries follow next in priority. Unfortunately,

in-season allocation decisions must be made primarily in the reverse order of priority, and under great uncertainty.

Day-to-day management of the Fraser River salmon stocks is the responsibility of the Pacific Region of DFO except in areas over which the Fraser River Panel of PSC has jurisdiction in years when there is agreement under the Treaty. Before each

*I wonder if anyone is left in the Department who remembers what the original picture of the DFO jigsaw puzzle looked like! Individuals within the Department enjoy the respect of stakeholders, but respect for Departmental decision making, implementation and industry consultation is at an all time low.*

Ms. Jean Shepherd, Gulf Trollers Association,  
Brief received November 21, 1994

year's fishing season, DFO develops a fish management plan. The fishing plan is developed based on preliminary forecasts of run size. This abundance forecast is based on data such as historical performance, spawning ground estimates, estimates of fish survival, counts of juvenile salmon before they leave the Fraser River and on the return of jacks to the Fraser in the previous year. Through these forecasts, escapement and catch objectives

are determined, and a management plan is designed by DFO to meet these objectives, setting out roughly how the fishery will be regulated.



The final approval of all fishing plans rests with the Minister of Fisheries and Oceans. Any change in federal government policy relating to the fishery and emanating from the Minister is incorporated into fishing plans.

In addition, DFO headquarters has been responsible for the approval of all Aboriginal agreements relating to fishing activity which give signatory First Nations input in management functions. Given all such Departmental responsibilities and the Board's mandate, we considered it important to examine not only the various monitoring and enforcement activities, but also the administrative structure and organizational framework within which these activities take place.

It is significant to note that the Department, particularly in the Pacific Region, went through a major reorganization during the period from late 1992 and into 1993 at the same time as sources of funding continued to decline. This period was characterized to the Board by one senior DFO official, with the general concurrence of others present, as a "reign of terror." Compounding the situation, the complexity of the fishery and management increased. We recognize that all federal departments were subject to

*I saw a dramatic reduction in DFO's presence on the fishing grounds this year. For instance, we were fishing on San Juan off the west coast of the Island and I was coming down from the west end from Bamfield, and we were kind of late; the fishery opens at 7:00 [pm] and it was already getting dark. And I was going along and noticed all these boats and nets in the water .... I was nearly four or five miles west of the front line and ... the whole fleet was across the line and there was not a single sign of DFO enforcement.*

Mr. Byron Nutton, Sierra Club of Western Canada,  
December 12, 1994, Victoria

resource reductions over the same period. We are concerned, however, that the combination of cutbacks and restructuring in DFO created a situation in which the ability to manage the entire spectrum of Departmental responsibilities was strained beyond capacity. The Board believes this led to a virtual loss of control in areas ranging from catch estimation to regulatory enforcement.

The Department's ability to discharge its responsibility and authority is dependent upon both the level of resources available and the manner in which those resources are deployed. Although Departmental staff told us that they were

making the best use of financial and human resources possible, their viewpoint is unconvincing and reflects a failure to assess objectively management performance in the 1994 season. Based on what we have learned, the Board believes that weak lines of communication and confusion over accountability were major contributors to the 1994 dilemma.

It is our view that, in 1994: (1) the morale of DFO enforcement officers was at a low ebb, (2) the timing of marine and in-river commercial openings and Aboriginal food fishing provided the opportunity for illegal fishing, (3) communications within DFO regarding potential illegal fishing activities went astray, (4) First Nation agreements were not in place until late in the season, (5) First Nation and DFO Fishery Officers were uncertain of their authority and what activities could be legally pursued, (6) most First Nation guardians and catch monitors were not given adequate training, (7) no agreements existed with important First Nation groups, and (8) communication between management entities and within DFO appeared strained.

Ironically, senior DFO officials seem to have been in a state of denial regarding the dysfunction within their organization and continue even today to assert that there

was no crisis in the 1994 salmon fishery.<sup>9</sup> The facts appear to say otherwise.

The combination of circumstances described in this chapter, if ever repeated, would once again put the resource at risk. For example, in the same circumstances as prevailed in 1994, a decision to allow 12 more hours of commercial

*... we're at a real crossroads in terms of where we're going. Is there going to be a future for the salmon? Is there going to be a future for the people that depend on the salmon?*

Mr. Dennis Brown, United Fishermen and Allied Workers' Union, November 29, 1994, Vancouver

seine fishing in the Johnstone Strait, Georgia Strait or northern Puget Sound would decimate the Late run sockeye and wipe out years of stock rebuilding.

The capacity of the seine fleet in Johnstone Strait in 1994 was such that, in a 12-hour opening on August 20, an estimated one million Fraser River sockeye were caught. Total spawning escapement for the Late run has been estimated at 1.5 million fish. Thus, one could argue that, with 90 percent of the Late run migrating through Johnstone Strait, an additional opening of the commercial fleet for 12 hours might have decimated the Late run including the Adams River stock.

With such an efficient fleet and the combination of environmental factors and suspect estimation techniques, any misinformed decision by fisheries managers would have devastating long term effects.

A press report attributes DFO officials as having said that even with 2.3 million fewer fish than anticipated to spawn, there are still plenty of salmon to lay eggs.<sup>10</sup> The Board cannot agree. As it was, the dominant year Adams River spawning escapement was reduced in 1994 to its lowest number since 1938.



## NOTES

1. Peter A. Larkin, *Analysis of Possible Causes of the Shortfall in Sockeye Spawners in the Fraser River. A Technical Appendix to Managing Salmon on the Fraser River*. Ottawa: DFO, 1992.
2. Roughly, the Panel is responsible for the southern portion of the west coast of Vancouver Island, Juan de Fuca Strait, and the southern portion of the Strait of Georgia, including the Fraser River below Mission. For areas outside the Panel's responsibility involving commercial fisheries on Fraser River sockeye salmon, including the Johnstone Strait and North Coast fishery, management responsibility lies with DFO. The Panel provides advice to DFO management on decisions pertaining to commercial fisheries which have an impact on the Fraser River sockeye.
3. Rapid feedback from the Mission facility provides PSC with an opportunity to correct errors in its estimates of the earlier runs. Late run sockeye mill about the mouth of the Fraser for three to six weeks. The fishing season is over before PSC can check their run size estimates. PSC plans to implement a test fishery at the lower end of Johnstone Strait next year to provide more timely feedback.
4. The list of possible factors under consideration includes inaccurate catch "hails"; inaccurate estimates of fishing effort; illegal catch; unreported catch; laundered catch; inaccurate mean weight estimates; misreported catch by area, date or gear type; errors in sockeye racial analysis; model mis-specification; diversion rate estimate errors; data outside previous range; changes to fish migration speed or migration distribution; and changes in fleet distribution and efficiency.
5. Pacific Salmon Commission memorandum dated January 27, 1994 regarding the November 1993 workshop.
6. *Department of Fisheries and Oceans Act*, RSC, 1985, c. F-15.
7. *Fisheries Act*, RSC, 1985, c. F-14.
8. *Regina v. Sparrow* (1990), 70 D.L.R. (4th) 385 (S.C.C.).
9. On February 3, 1995, *The Globe and Mail* (p. A3) reported a sentiment among senior DFO officials that there never was a crisis, and that any shortfall was due to counting error or environmental conditions, without any suggestion of possible management problems.
10. *Ibid.*

# 3

## *The Board's Findings*

### **INTRODUCTION**

Thus far, we have reviewed the history of the Fraser River salmon fishery to place the 1994 mystery in context, and we have considered various technical and administrative issues related to our mandate. Having reviewed technical information and listened to the opinions of many intervenors, we must conclude that there is no single explanation for the 1994 problem. While a number of factors likely interacted in the missing salmon issue, the Board sees no reason to assign proportional weights to any of them.

Much of the information we received would not be considered evidence in a court of law. But our task was to study a problem and advance solutions to prevent the problem from recurring. In seeking solutions, the Board believes that the views of all stakeholders and the public must be taken into account.

In its efforts to respond effectively and objectively to its Terms of Reference, the Board has listened carefully to fisheries managers, considered well over 100 written briefs, heard dozens of oral interventions from diverse groups, reviewed extensive background materials and discussed and debated the underlying nature of the 1994 sockeye salmon season. During this process we were struck by the similarity between the problems confronted by managers in 1994 and those faced in 1992. In this sense it is useful to note the findings of Dr. Pearse who concluded that:<sup>1</sup>

1. The fishery was generally well managed in spite of weaknesses and deficiencies, particularly with respect to the then new Aboriginal Fisheries Strategy. AFS agreements were thought to be inadequate to control catches and ensure escapement and to have contributed to an erosion of public confidence in the fishery management system. It was indicated that confidence in the system would be difficult to repair if the causes of the turmoil were allowed to continue;
2. The different AFS arrangements on the upper and lower parts of the Fraser River exacerbated management and enforcement difficulties. The authorization of fish sales in the lower Fraser was seen to have complicated the management of Aboriginal fisheries in areas where no sales were permitted;

3. Progress in advancing the new policy was impeded by a general perception that fishing was out of control on the Fraser in 1992; and
4. The combined effect of the various events in 1992 had seriously damaged public confidence, which could only be restored through a concerted and co-ordinated commitment to conservation on the part of all user groups.

**We wonder if anybody is listening.**

While the issues confronted by this Board are similar to those faced by Dr. Pearse, we had to bear in mind that our mandate extends well beyond in-river issues. In 1992,

*Past recommendations have fallen on deaf ears and we do not intend to allow that to happen again with this review.*

Chief Robert Pasco, Nlaka'pamux Tribal Council,  
December 7, 1994, Chilliwack

managers could not account for a significant number of fish above Mission. The 1994 situation involved an inability to account for an even larger number of fish above Mission, but also involved a significant shortage of Late run sockeye arriving at Mission. Dr. Pearse noted that "the summer of 1992

was not so much a crisis in resources management as a crisis of policy"<sup>2</sup> and that "failure to achieve escapement targets...was not a disaster but the program of rebuilding sockeye stocks — especially the Early Stuart — ...suffered a setback. **It cannot be repeated without seriously threatening salmon resources.**" [emphasis added]<sup>3</sup>

But the problems have not gone away, and fisheries managers were unable to account for even more sockeye in 1994. Though 1994 catches were abundant, spawning targets were not reached.

As has been noted, the Adams River run — the most famous of the Fraser River sockeye runs — had its lowest dominant year spawning escapement since 1938. The Early Stuart run was less than one third of its in-season escapement goal. Other runs were also below targetted spawning levels. Although it is clear that the shortfalls in escapement targets do not compare with the demise of the Atlantic cod, 1994 must still be considered a major setback in the Fraser River stock rebuilding program.<sup>4</sup> The Board is convinced that unless all parties work together and manage much more competently, the tragedy that befell the Atlantic cod fishery could happen here.

In many respects the frustration of 1994 lies in the fact that no one, including the authorities, the experts and this Board, knows precisely what happened or exactly how it happened. After a thorough appraisal of the methodology, estimates and potential

errors, the Board feels the information available does not warrant a further exercise in accounting for the unaccounted. However, this is no excuse for not taking action to ensure that what happened in 1994 does not happen again.

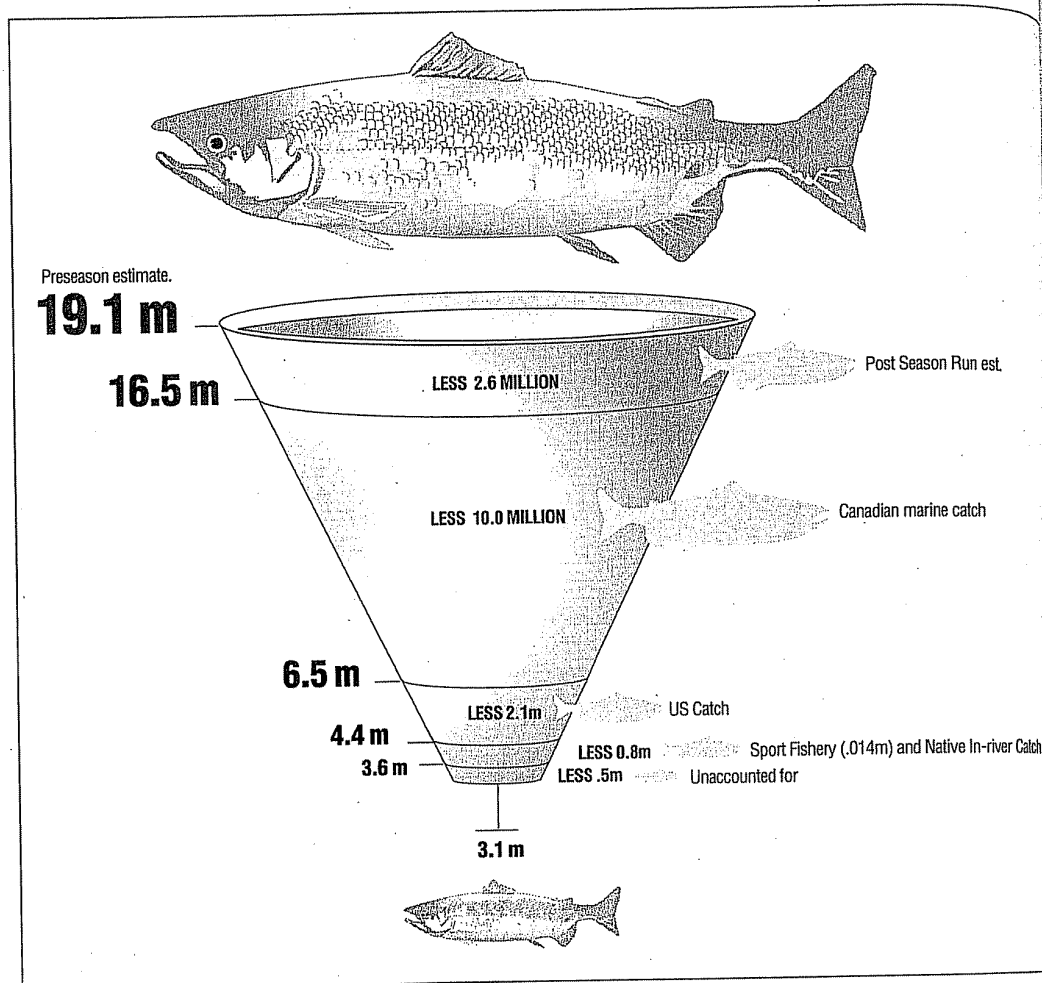
Although the difficulties confronting managers resulting from run diversions and illegal fishing complicated the managers' jobs, perhaps an over-reliance on the quality of historic in-season estimates, and an optimistic attitude regarding the run size, fostered risky management decisions in 1994. Catch accumulated rapidly and by season's end the total Canadian ocean and in-river catch of about 11 million pieces and a U.S. catch exceeding two million pieces pushed the annual harvest to about 13 million.<sup>5</sup> Using a post-season run estimate of 16.5 million, the annual harvest rate was almost 80 percent. Considering all the uncertainties of 1994, it was certainly not a risk aversion management process.

Resource management problems in 1994 were aggravated by:

1. a breakdown in enforcement or the perception of a breakdown in enforcement;
2. failure to secure timely and comprehensive arrangements with First Nations peoples;
3. anomalous ocean and in-river environmental conditions;
4. significant errors in estimating in-season marine run and stock sizes leading to an inability to deliver adequate fish to meet spawning escapement targets and in-river catch allocations;
5. delays in accurate catch reporting;
6. flawed management structures and communications between DFO, PSC and First Nations groups as well as within DFO;
7. deteriorating DFO staff morale in enforcement and other work areas; and
8. an indeterminate level of illegal marine and freshwater fishing.

These topical problem areas are discussed in more detail under broader substantive issues as follows: (1) Management (including risk aversion, institutional arrangements and quality management), (2) Enforcement, (3) Aboriginal Fisheries Strategy, (4) Environment, and (5) User group views and responsibilities.

**Figure E**  
**THE FISH SIEVE**



*The fate of 19.1 million sockeye forecast to return to the Fraser River in 1994.  
Source: DFO computer run, catch date, Nov. 1, 1994.*

## **MANAGEMENT**

### ***Risk Aversion Management***

Fiscal commitment to fund natural resource management has diminished in recent years, and the overall budget available for DFO Pacific management activities is less than it was prior to Canada taking over full responsibility of the Fraser River fishery in the wake of the Treaty. This has taken place despite increased DFO responsibility and considerable international push by Canada for increased national and international commitments to enforcement, surveillance and conservation of ocean fisheries.

The management process for the Fraser River sockeye, like that of many world fisheries, is based on landing data that are often incomplete until well after the season is over, and a variety of estimators that are subject to potential bias and error. For the Fraser the most important of these include: (a) timely marine and in-river catch data; (b) in-season run size, run timing and diversion rate estimates; (c) estimates of escape-past Mission; (d) en-route mortality estimates; and (e) spawning ground estimates.

All these parameters constitute important elements in formulating management decisions. The accuracy of many of these estimates appears to have eroded in recent years as a result of changes in migration patterns, unusual environmental conditions within the river, increased complexity of the fishery, new methods employed to gather catch data and declining numbers of scientific, management and enforcement personnel available to carry out management tasks. These problems have caused a growing lack of confidence in the management system, which has in turn led to a breakdown in compliance and a further loss of accuracy in the estimates.

Examples of uncertainty in these estimates are as follows:

<b>Estimate</b>	<b>Extent of Uncertainty</b>
Marine Catch	15 percent underestimate of Johnstone Strait seine catch (as of January 31, 1995) <sup>6</sup>  Indeterminate illegal catch
In-River Catch	Lack of firm information on the extent of non-compliance with landing procedures  Limited catch monitoring and enforcement in key areas  Indeterminate illegal catch

In-Season Run Size	Overestimate of 1.5 million for Late run sockeye in Georgia Strait <sup>7</sup>
Mission Escapement	Potential for 20 percent positive bias and unknown negative bias
En-Route Mortality	No direct, quantitative measurement on which to base estimates
Spawning Ground Escapement	Potential for visual surveys to underestimate by 50 percent or more

As can be seen, the 1994 season was replete with issues of uncertainty. In-season estimates of the late runs were apparently inaccurate, resulting in failure to achieve desired escapement goals. Some Aboriginal allocations were not met, and harvest rates in Johnstone Strait were higher than anticipated. These problems were not detected until it was too late to take remedial action. In-river management was equally complicated by the uncertainty of the disposition of runs passing Mission, en-route mortality and catch accounting problems. It is essential that in-season management decisions take these factors into account. One action that could contribute to this goal would be the reduction of the harvest rate for each opening of seine fisheries.

Although DFO and PSC staff have informal practices and ideas for dealing with the uncertainties, there is no formal, universally accepted, publicly available policy. Too often, estimates are labelled as "counts," and the uncertainties are ignored. There has never been a thorough study of the risks associated with the present management regime.

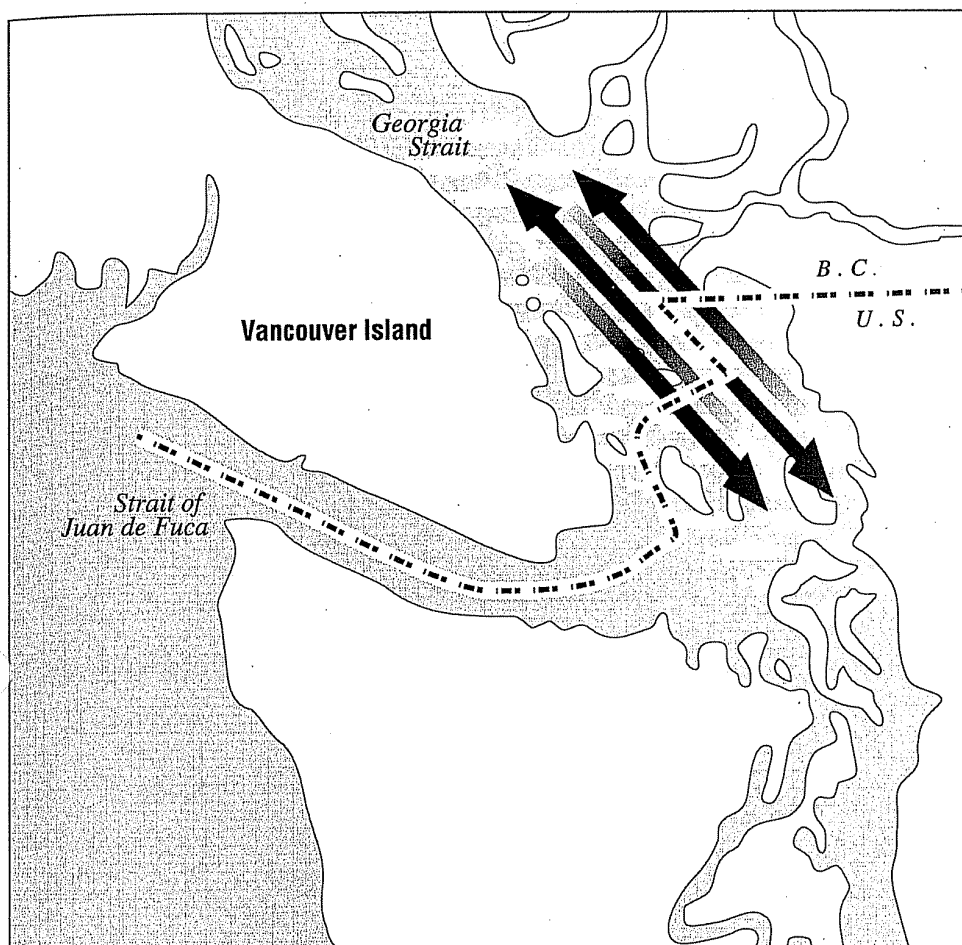
*A haphazard aggressive fishing war is potentially analogous to clear-cutting B.C.'s steelhead and salmon stocks. In southwestern B.C., one-third of the spawning populations identified by the early 1950s have been lost or have decreased to such an extent that spawners are no longer consistently monitored.*

Dr. Craig Orr, Executive Director, Steelhead Society of B.C., December 6, 1994, Chilliwack

Despite warnings from the November 1993 PSC workshop,<sup>8</sup> the management system was incapable of reacting appropriately to the large uncertainties in these estimates. In 1994 these uncertainties were compounded by a very high diversion rate and may have resulted in an in-season overestimation by PSC of the Late run, including the Adams River run. Many individuals have told us that, in their

opinion, the management errors that occurred in 1994 were bound to be made sooner or later. We are fortunate that the damage was not even worse, and immediate corrective action must be taken.

**Figure F**  
**MILLING PATTERNS**  
**LATE RUN SOCKEYE 1994**



*Movement of Late run sockeye prior to entering the Fraser River, showing the vulnerability to the U.S. commercial fleet.*



All the uncertainties which we have noted were compounded in 1994 because Canada and the United States failed to reach an agreement under the Treaty. American

*... in the end I would have to say that the position we are in here is of a serious enough nature that private rights may have to become secondary to the common good, i.e., conservation and good management of the resource. That would be my personal opinion.*

Mr. Mike Hunter, President, Fisheries Council of British Columbia, November 29, 1994, Vancouver

fishers, confronted with Canada's aggressive fishing strategy, could have decimated the Late run. A diversion rate resulting in limited fishing opportunities in the Juan de Fuca Strait caused the U.S. fleet to rush to an area off Point Roberts north of Puget Sound to catch as many Late run fish as possible at the mouth of the Fraser. When informed at the last minute that no more fishing should take place

in order to achieve escapement goals, those U.S. fishers reluctantly ceased fishing, disturbed by the lack of prior notice and by the fact that further Aboriginal fishing was planned to continue in Canada even though American fishers were being asked to stop fishing for conservation purposes. It is important to note that the U.S. fishers were not obliged to stop fishing, and it should not be assumed that they would cease fishing voluntarily the next time.

In light of the 1994 experience, we believe that DFO and PSC should without delay begin developing comprehensive risk aversion management plans. The objective

would be to reduce substantially the risk of a major setback to conservation goals.

*The current rate of commercial harvest leaves absolutely no room for any margin of error. Combined harvest rates this year are reported to be around 80 to 90 percent of the run size. If the pre- and in-season estimates of the PSC are even slightly inaccurate — and it must be remembered that these figures are only estimates — then the salmon are extremely vulnerable to overharvesting.*

Ms. Catherine Stewart, Greenpeace Canada, November 29, 1994, Vancouver

The first step must be to establish clear conservation goals. DFO has been executing a long-term plan to increase gradually the spawning escapements. The objective has been to increase runs and thereby test the capacity of the Fraser for sock-eye production. The conservation mandate was translated by DFO into a plan to maintain spawning escapement at least to the level of the previous brood stock. A flexible

escapement policy was developed. If the returns were large, the escapement target was raised; if fewer fish returned, the target was lowered.

This strategy provides opportunities for growth in spawning escapements in years with good returns, while permitting maximum harvests without setbacks to

spawning escapement in years with disappointing returns. It may well be far from optimal, even solely from an economic perspective. This policy is questionable in light of the many uncertainties facing in-season management.

In the past, as reasonably stable run size estimates were developed, they were used to determine the escapement target and to

***The Department of Fisheries and Oceans must eliminate management techniques that are designed to achieve optimum harvest upon major stocks, regardless of the harvest impacts upon smaller stocks.***

Mr. Ernie Crey, Sto:lo Fisheries Authority,  
December 13, 1994, Campbell River

reach decisions on harvest levels. In retrospect, it is clear that estimate uncertainties received inadequate attention in making these decisions. There was a laxity of diligence. Risk aversion management planning must describe how uncertainty in estimations will be handled at key points in the sockeye season.



## RECOMMENDATIONS



1. We recommend that DFO retain and exercise its constitutional conservation responsibilities and not in any way abrogate its stewardship of resources under federal jurisdiction. Conservation must be the primary objective of both fisheries managers and all others participating in the fishery. The conservation ethic must prevail throughout and be adhered to by all.
2. We recommend that DFO take immediate steps to initiate a process of planning for the future of the fishery, addressing all critical problems affecting conservation and sustainability, through an ongoing consultative forum. Among the problems to be considered would be over-capitalization, user-group allocation and ensuring equitable treatment under the law.
3. We recommend that DFO and PSC adopt a risk aversion management strategy because of the great uncertainty in stock estimates, in-season catch estimates and environmental problems. Conservation goals must be achieved before any other priorities are addressed.

4. We recommend that DFO, in conjunction with provincial authorities, First Nations, commercial and recreational fishery groups, implement (both in marine and in-river areas) a revised system to ensure that catch information is timely and reliable, given that accurate counting and timely reporting of catch are fundamental to conservation. The system must also include a more stringent paper trail wherein there must be stricter control of landing and sales slips and a mandatory retention of sales slips with fish through to retail sale or export.
5. We recommend that DFO explore the application of new technology to collect information on stock levels in ocean areas in order to supplement catch statistics.

### ***Institutional Arrangements***

The management strategy for the 1994 sockeye salmon season differed markedly from what had been in place since 1985 under the Pacific Salmon Treaty. Canada, in response to a dispute over catch-sharing and conservation, notified the U.S. government on July 28, 1994 of its intent to have DFO assume full responsibility for managing Fraser-bound sockeye in all Pacific waters under Canadian jurisdiction. The Washington Department of Fisheries and the Northwest Tribal Fisheries Commission, on the other hand, would share management of those fisheries in U.S. waters.

While DFO continued to provide technical input to PSC's Fraser River Technical Panel in the period leading up to the sockeye season, U.S. agencies were not consulted on management decisions from the time Canada announced its intent to go it alone. Information continued to be exchanged throughout the season using PSC staff as a conduit.

The Fraser River Panel, comprising representatives from both nations, PSC staff and non-governmental participants,<sup>9</sup> functioned in 1994 before Canada's withdrawal from the bilateral process. Subsequently, independently designed Canadian and U.S. pre-season fish management plans, based on pre-season stock forecasts and diversion estimates provided by Canada, were not co-ordinated, as would have been the case if agreement had been reached under the Treaty.

On June 9, 1994 the Minister of Fisheries and Oceans created an Advisory Panel on Pacific Salmon with representatives of recreational, commercial and Aboriginal fisheries. This Panel was struck to provide DFO with outside advice on the conduct of salmon fisheries, including a strategy of aggressive fishing, intended to bring the United States back to the negotiating table.

Even though Canada assumed full control of sockeye fisheries within its own waters, PSC technical staff continued to function as usual. PSC staff received, collected, analyzed and provided crucial in-season information to the management agencies of both countries.<sup>10</sup>

While the Canadian section of the Fraser River Panel had no fisheries management responsibility in 1994, it provided an important advisory service to DFO management, blending the views of the many Canadian fisheries interests and its own assessment of PSC staff technical analyses.

Another consultative forum for Canadian fisheries managers was that created under the Fraser River Watershed Agreement.<sup>11</sup> The Agreement, which is between numerous First Nations and DFO, creates a structure for co-ordination of policy development and long-range planning, fisheries management, fish enhancement, fish and habitat protection and aims to ensure the equity of resourcing among First Nations in the Fraser watershed. The committee structure under the Agreement currently consists of the Watershed Steering Committee overseeing in 1994 the Harvest Committee,

the Monitoring and Enforcement Committee and the Habitat and Enhancement Committee. All of these committees draw members from the various First Nations and DFO.

The function of the Harvest Committee in 1994 was to develop fish harvest plans and recommend production, stock assessment, monitoring and enforcement plans and other related matters of interest and

*The way I see it today, we ain't going nowhere. We can have meetings and meetings like this and it ain't going to change nothing till people can start respecting what some of the Native people are saying and what we have to offer.*

Mr. Ralph Philips, Cariboo Tribal Council,  
January 12, 1995, Williams Lake

concern to the signatory First Nations. Under the Watershed Agreement, DFO implements fisheries management measures agreed upon by the Harvest Committee. Should no consensus emerge from the Harvest Committee, the DFO representative can make a final decision after consulting with the Chair.

DFO has a complex internal fisheries management system which reflects geography and the diversity of interests involved in the various stocks of Fraser-bound sockeye. Three Area Managers<sup>12</sup> communicated regularly among themselves and with the Regional Co-ordinator of Fisheries Management (who reported to the Director of Operations, Pacific Region) during the 1994 sockeye season. The Regional Co-ordinator apparently had the authority to intervene in management decisions in the event there was no consensus among Area Managers. In addition, all of these officials

maintained regular contact with the Canadian section of the Fraser Panel, especially during the peak of the sockeye season.

The science branch of DFO provided pre-season estimates of the diversion rate of Fraser River sockeye to Departmental managers, PSC and U.S. agencies. As the sockeye migration progressed through Canadian waters, in-season responsibility for estimates of stock diversion passed over to PSC staff and were adjusted weekly on the basis of new catch information generated by the various harvest fisheries.

Responsibility for pre-season abundance forecasts resided in DFO's Stock Assessment Division. This responsibility also passed to PSC staff in-season. In addition, the Division was responsible for the design and implementation of the 1994 spawning ground enumeration program.

DFO's Conservation and Protection Division (C&P) was responsible for enforcement, with supervisory C&P units in each of the three Area offices and enforcement staff in various field offices within each Area. In addition, small General Investigation Services units were attached to each Area office to undertake special investigations and surveillance activities. Operational direction was provided by Area Managers and functional direction by the Director, C&P Branch, located in Pacific Region headquarters. C&P personnel had some limited opportunities to provide input to fisheries management planning.

Vessels with 24-hour capability from DFO's Ships Branch were assigned on an as-needed basis to undertake in-season surveillance and monitoring patrols at pressure points in the fishery. Other Departmental vessels charged with in-season patrol responsibilities in particular areas were generally restricted to daytime hours unless overtime was authorized. These vessels contributed to fisheries management through the collection of data on fishing vessels and daily catch and aided in enforcement (short of laying charges). They also provided a platform and support for staff engaged in various activities related to conservation and protection of fish resources.

Seasonal Fishery Officers, guardians and coast patrollers were retained during the season to supplement DFO's complement of full-time monitoring and enforcement staff. Their duties included preventing illegal activities, surveillance, monitoring fisheries, protecting fish habitat, protecting salmon escapement in-river and on the spawning grounds, and aiding in enforcement (often short of laying charges). They received direction from C&P supervisory staff.

The Aboriginal Affairs Branch in DFO's Pacific Region assisted headquarters' Aboriginal Affairs Directorate in the development and implementation of agreements made under the AFS. In 1994 not all Aboriginal communities in the Fraser watershed signed agreements. Even for those agreements which were signed, implementation was

in many cases delayed until late in the sockeye season or even until after the season. Area administrators often participated in the negotiation of those agreements which were concluded.

As usual, within each of DFO's three Areas, pre-season consultations were held in 1994 with various user groups. During the season, the Canadian section of the Fraser River Panel was the primary channel for advisory input. Consultation opportunities with Aboriginal groups varied among the Areas.

PSC staff held a post-season public workshop in early February of this year to review the 1994 sockeye fishery. Attendance was broad, drawing from technical and managerial staff from both Canada and the United States and other groups that interacted during the planning and implementation of the various sockeye fisheries.

### **Institutional Problems in 1994**

The Board has a number of concerns arising out of its review of the institutional arrangements existing in 1994.

First, members of the Minister's special Advisory Panel, which contributed to the development of the aggressive fishing strategy, were able to participate in meetings of the Canadian section of the Fraser Panel. By August, Aboriginal representatives had withdrawn from the panel process out of concern that the strategy did not properly address conservation issues. A less than prudent attitude growing out of the aggressive fishing strategy took hold and affected behaviour in all areas, whether or not they fell within the intended scope of the strategy. This occurred to the detriment of conservation.

Further, DFO administration was fragmented, with no overall direction from senior levels in Pacific Region. Responsibility for overall direction appears to have been pushed down to the Regional Co-ordinator of Fisheries Management, who was forced to make key decisions without clearly defined lines of accountability. In our view the decision process lacked clarity.

We have heard little to suggest that managers took sufficient account of the significance of the combination of in-season conditions that prevailed in 1994, i.e., high in-river temperatures; extreme diversion rate; the magnitude of the breakdown in compliance in both the marine and in-river environments; the unreliability of landing data; the uncertain control over AFS fisheries (both for pilot sales and food); the inadequate levels of surveillance, monitoring and enforcement; and the potential for a U.S. commercial fishery on the Late run sockeye without the controls normally in place when there is bilateral agreement under the Treaty. There appeared to be no adjustment to the pre-season decision to fish to the maximum.



It is unclear whether in 1994 DFO operated from an institutional plan that was understood at all levels of the Pacific Region organization. Our doubts about the

***AFS in my view throws that extra little bit of complication into management.***

Mr. John Cummins, MP, (Delta) February 3, 1995, Vancouver

Region's internal readiness to meet the challenges it faces are exemplified in its apparent lack of both a regulatory plan and a performance analysis plan. Most certainly, the absence of a regulatory plan under-

mined enforcement and contributed substantially to the widespread breakdown of compliance which is strongly suspected to have occurred in 1994. Also, the lack of an in-depth performance review involving every level of the organization immediately following the end of fishing in 1994 was a serious omission. Such a review would have been crucial in assessing problems and developing measures to improve matters before the onset of the 1995 fishing season.

One problem which would have become clear after such a review is the collapse of enforcement efforts in 1994. This issue is of such importance that it is discussed separately in detail later in this chapter.

As we have noted, those AFS agreements which were signed in 1994 were, in many cases, not implemented until late in the season or even until after it had ended.

***The Province is concerned about the maintenance of the vital salmon resource that supports a wide range of needs and interests, jobs and communities throughout the Province. It is the Province's view that the conservation program was first seriously weakened in 1992 by inadequate management of the Aboriginal Fisheries Strategy (AFS) on the Fraser River.***

Mr. J.D. Anderson, Aquaculture & Commercial Fisheries Branch, B.C. Ministry of Agriculture, Fisheries and Food, Brief received December 1, 1994

This complicated matters for fisheries managers and enforcement staff. Establishing monitoring programs and enforcing catch targets for every harvesting group, Aboriginal or otherwise, is a prerequisite to effective fisheries management. Ad hoc arrangements, put in place with some First Nations without giving due consideration to the issue of enforcement, caused uncertainty and confusion to prevail, thereby fostering an environment in which illegal fishing could occur and be cloaked by legitimate Aboriginal fisheries. We received

no indication from DFO of the existence of any contingency management and enforcement plans in the event that negotiations failed to result in signed AFS agreements.

Also, there appeared to be no real DFO plan to develop the institutional infrastructure needed for First Nations to assume the responsibilities negotiated under

co-operative fishery agreements. While the overarching Fraser River Watershed Agreement describes multi-committee institutional arrangements, we note that in 1994 some of the Aboriginal fishing authorities which exercised management and enforcement powers under AFS agreements were themselves unincorporated *ad hoc* entities. Furthermore, beyond the Fraser watershed in Georgia and Johnstone Straits, where no agreements were in place, food fishing was carried out under the aegis of local Tribal authorities without adequate co-ordination within DFO.

Having come this far in our discussion of the institutional arrangements and problems which had an impact on the 1994 fishery, we are drawn to the conclusion that communication both within and between certain entities is an area where there is much room for improvement. This point can be made by noting the following observations about:

### ***Communication within DFO***

- ◆ Lines of authority and accountability between headquarters and Pacific Region must be clarified if there is to be certainty about who is in charge in any particular situation. Communication signals become confused when responsibility is transferred without concomitant authority. Clearly established authority would enhance accountability and result in a more open and timely flow of information throughout the system. In the case at hand, we suspect that direct national headquarters involvement in negotiating AFS agreements without full involvement of Pacific Region managers left the latter in the position of having to prepare their management and enforcement plans with incomplete information.
- ◆ The Board believes that communication links were weak between and among the various branches of DFO at all levels. This seems to have been the case for the C&P Division in particular, but also is problematic for the Aboriginal Affairs, Fisheries Operations (responsible for fishery management), and Science and Habitat Branches. Sectoral administration currently practised by DFO requires sophisticated co-ordination mechanisms and an open communication system. Few of these necessary arrangements seem to have been in place in 1994. Regional and higher level management seemed to be serenely unaware of the chaos this communication breakdown created. For example, field staff told us of their frustrations at often being kept unaware of such need-to-know matters as the timing and extent of fishery openings, catch limits and conditions on Aboriginal fishery licences.



### **Communication between DFO and PSC**

- ◆ While one observer characterized the relationship that existed in 1994 as "collegial," the Board has concluded that this would be a generous interpretation of the situation. Whereas communications did take place as required, we have the sense that the spirit underlying the relationship between these organizations in 1994 would better be described as competitive rather than team-oriented. We urge these two key organizations to make every effort to communicate freely and openly for the general good of the resource.

*A previous Minister of Fisheries said one time good fisheries management depends on the two book-ends, one is good science and one is good enforcement. And it's clear that both book-ends are falling off the table if they're not gone already.*

Mr. Paddy Greene, Northern Representative, B.C.  
Survival Coalition, January 9, 1995, Prince Rupert

- ◆ Close communication links between Canadian and U.S. managers through PSC are even more important to maintain in years when there is no agreement under the Treaty. Practical understanding and cross-boundary sharing of information will enhance the in-season management process.

### **Communication between DFO and First Nations**

- ◆ Whereas poor communication links between DFO national headquarters and First Nations may have contributed in part to the slowness of AFS negotiations, the more important issue in this relationship is the lack of confidence which First Nations appear to have in regional DFO officials. This is exacerbated by the usual desire of First Nations to deal directly with Ottawa on most issues. This impeded the Region's ability to implement co-operative fisheries management agreements and to carry out effective enforcement. Improved communication lines between First Nations and DFO Regional staff would have significant benefits.

### **Communication between PSC and First Nations**

- ◆ First Nations have representation on PSC, the Fraser River Panel and the Fraser River Technical Committee. Strong efforts are warranted to encourage ongoing and active participation of First Nations in PSC planning and review processes.

### ***Communication between DFO and Other User Groups***

- ◆ Both DFO and PSC could obtain valuable in-season information on the status of the sockeye runs by forging stronger co-operative lines of communication with the commercial and recreational sectors. Although these arrangements may now occur on an ad hoc basis, they are easily lost when staff who have established good relationships with these sectors move on to other duties. These communication links must be solidified and made more permanent.

### **In-Season Management of Fraser River Sockeye**

In years when there is agreement under the Treaty, PSC is responsible for ensuring that enough fish avoid the coastal fisheries to meet escapement goals for salmon passing

***There needs to be more central authority through a bilateral panel to meet escapement goals.***

Mr. William Robinson, Fraser River Panel,  
U.S. Section, Pacific Salmon Commission,  
February 1, 1995, Bellingham, WA

Mission. The in-season management process is so fragmented that PSC does not have adequate control to ensure that these goals are met in conditions such as occurred in 1994. Conservation objectives will continue to be placed at risk if the responsibility for escapement to Mission is not matched with adequate management authority.

This could be achieved by vesting the Canadian section of the Fraser River Panel with responsibility for in-season management for the sockeye and pink salmon fisheries in Canadian waters beyond the current PSC convention area.

### **Proposed Pacific Fisheries Conservation Council**

Having discussed current institutional arrangements at some length, we believe that the objective of sustainable fisheries management would be advanced by the creation of an independent body which, for the purposes of discussion, we call the "Pacific Fisheries Conservation Council." The Council would act as a public watchdog agency with no vested interest except the health of the fish and their habitats. While the Board sees merit in the suggestion of the Government of British Columbia that such an agency be created with hands-on regulatory responsibilities, that concept would require more time and complex negotiations before it could be implemented. In the meantime, the Council we conceive could be put in place with less difficulty and would operate more through moral suasion than direct regulation.

Such a council could be initiated through a Memorandum of Understanding or some form of federal-provincial agreement encompassing, but not necessarily limited to, the following matters:

- ◆ A mandate which extends beyond salmon to encompass all species of fish in the Pacific region, both commercial and non-commercial;
- ◆ Public accountability for fisheries conservation through an annual "state of stocks report" to federal and provincial ministers responsible for fisheries and to the public;
- ◆ A framework of principles encouraging co-operation and active participation among public and private sector fisheries conservation agencies;
- ◆ A mechanism to provide regular advice to ministers on priorities for research, enhancement and habitat renewal;
- ◆ A mechanism to provide comment to ministers on matters perceived to have potential positive or negative impact on the achievement of conservation goals;
- ◆ A mechanism to ensure widespread dissemination of information promoting the importance of fisheries to the well being of British Columbians and all Canadians; and
- ◆ Authority to require pertinent government agencies to provide technical and scientific information relevant to the proper fulfilment of the Council's responsibilities.

Independent accountability is an essential condition for building public confidence in the fairness, rationality and effectiveness of fisheries resource conservation policies, priorities, strategies and activities.

The text opposite provides some thoughts on how such a council might function.

### **PACIFIC FISHERIES CONSERVATION COUNCIL**

- ◆ Meetings of the Council would be on an as-required basis in the first two years and not less than quarterly thereafter.
- ◆ Public meetings would be conducted from time to time in coastal and inland communities to create opportunity for local input.
- ◆ The Chair would be appointed by agreement of Ministers for a 3-year term (with no renewal beyond 6 years).
- ◆ Membership would be at the invitation of Ministers on the advice of the Chair and would:
  - ensure geographic representation
  - avoid conflict of interest appointments
  - be for 3 years on a rotational basis
  - be limited to a maximum of 7 people
- ◆ The Council would be supported by a full-time technical staff of about 6-8 persons.
- ◆ The Council would be empowered to contract from time to time for independent analytical and scientific support.
- ◆ The Council would establish an Advisory Committee with representation from government agencies, sectors of the fishery, other resource sectors, and private citizens.



## RECOMMENDATIONS



6. We recommend that DFO develop better co-ordinated inter-party communications among its staff and between its staff and PSC, First Nations, commercial and recreational fishing groups, with a greater degree of co-operation aimed at enhanced in-season management and post-season evaluation and at fostering closer working arrangements among all parties, and facilitate clearer and more transparent management and allocation policies.
7. We recommend that DFO and PSC give First Nations greater and more meaningful access to, and involvement in, the management process.
8. We recommend that DFO, PSC, First Nations and user groups institute a formalized pre-season review of each season's management plans and strategies, to be followed by a post-season performance analysis. Independent experts should be invited to assist in extending the range of expertise and in promoting transparency in the management process.
9. We recommend that the Canadian section of the Fraser River Panel be vested with responsibility for in-season management for Fraser River sockeye and pink salmon fisheries in Canadian waters beyond the current PSC Convention area. Further, to facilitate communication and understanding (between DFO and PSC) of the in-season run and stock size estimates, a member of the DFO Stock Assessment Division be assigned to work closely with PSC during planning, estimation and evolution of run estimating procedures. There is also a need for practical arrangements for in-season communications between the U.S. and Canadian sides of the Fraser River Panel, whether or not there is formal diplomatic agreement.
10. We recommend that an independent Pacific Fisheries Conservation Council be established to act as a public watchdog for the fishery, to report to ministers and the public annually and from time to time as is appropriate.

### **Quality Management Principles**

Administrative and structural problems within DFO contributed to much of the disarray in the 1994 season. Components of the system had been allowed to evolve without a thorough assessment of their overall impact. Budget cuts had been imposed and addi-

*I would suggest that there are far too any people carrying papers back and forth to each others' offices and not enough people out there doing what their mandate has actually asked that they do.*

Ms. Debra Logan, B.C. Shellfish Growers Association,  
December 12, 1994, Victoria

tional responsibilities absorbed with inadequate regard for the capacity of the system to meet its increasingly complex goals. Furthermore, there was no system-wide consensus on what these goals ought to be.

There is a clear need for improved quality management. This is not unique to the public sector. The quality management

movement gained initial impetus in reaction to the phenomenal post-war success of Japanese industry. This was traced in part to Japan's implementation of quality control methods developed elsewhere. A major component of the strategy, which is now being emulated, is the creation and implementation of management plans to ensure that products are of high quality, and the assurance that potential customers are aware of adherence to such plans. In fact, many companies now insist that their suppliers demonstrate compliance with quality management principles. It is becoming increasingly common for such compliance to be demonstrated through an external auditing program. Once a company makes its initial commitment to the principles of quality management, it takes, on average, two years to fully develop a program which can demonstrate success. In the public sector and major service industries, successful completion of all the necessary steps can be even more complex.

Quality management requires commitment. Commitment requires incentive. In the private sector, unhappy customers and investors can provide a strong, direct incentive for change. A quality management system would be judged ultimately on its success in meeting measurable objectives. The audits would look for evidence of quality management and probe all areas of operations. Procedures and results would be available to the public.



## RECOMMENDATION



11. We recommend that DFO make a commitment to quality management principles in the management of fish stocks by Pacific Region and, in this context, that a third-party quality auditing organization be contracted to provide ongoing services.

## ENFORCEMENT

In 1994, a culmination of long-term budget decline, organizational change, increasing enforcement demands and low morale led to an unfortunate breakdown in DFO enforcement capacity.

During 1994, enforcement appears to have been given a low priority. A growing perception has evolved that the vast area and difficulties of enforcement in the Fraser River watershed and elsewhere prevented an effective program. DFO's corrective prescription for illegal fishing was to rely on user group ethics and increased public commitments to conservation goals. This was, from the Board's view, laudable and desirable. Unfortunately, growing discontent with the administration of the Aboriginal fisheries, among both Natives and non-Natives, resulted in increasing attitudinal anarchy in marine and in-river areas during 1994. Starting with the reorganization of 1992, staff and budget for surveillance, monitoring and enforcement declined. There was a very widespread feeling that DFO was no longer seriously prepared to enforce its own rules. This contributed directly to plummeting morale among Fishery Officers and a serious loss of confidence among user groups and the public.

The present organizational structure has contributed to ineffective communication links between DFO fisheries managers, AFS staff and enforcement staff. The Board has heard that on many occasions enforcement staff were not informed of commercial and Aboriginal fisheries openings until the day before the opening, and in some instances were not informed at all. Fishery Officers indicated that communications about changes to policy and regulations were equally slow.

A sharply reduced complement of uniformed enforcement staff in 1994 (down by 47 percent from 1989) and a reduced complement of seasonal staff, Departmental vessels and chartered coastal patrol vessels with enforcement capability vastly increased the geographic responsibility of the remaining staff. For example, the seasonal coastal patrol vessels and personnel, necessary to supplement regular DFO surveillance, monitoring and enforcement capacity were directed to be reduced by 25 percent annually. And further, at the start of the 1994 season, these personnel had their enforcement authority to board vessels or to lay charges removed. Large areas of the coast and

interior were left without effective protection, creating low-risk opportunities for poachers and for those who have no regard for fish habitat.

***DFO must have ... competent, trained and properly-equipped vessels and personnel in the field to monitor and protect the resource. The management and protection of the resource must be the prime mandate.***

Captain Ken Widsten, President, Coastal Patrol Association, January 20, 1995, Kamloops

compared to the same period in 1993. Despite communications from the field predicting a repeat of the 1992 "missing" fish problem, this trend continued throughout the summer further demoralizing field personnel.

***The present system of the Aboriginal Fisheries Strategy is inadequate and therefore must be revamped to allow for proper training of guardians and the agreement should be suitable to all, or else the fish will be lost forever.***

Chief Mike Leach, Nlaka'pamux Tribal Council, December 7, 1994, Chilliwack

agreements which called for the hiring of Aboriginal Fishery Officers to assist in the enforcement of this fishery had major deficiencies. These include:

- ◆ Inadequate training of Aboriginal Fishery Officers;
- ◆ Seasonal hiring of Aboriginal Fishery Officers contributing to a difficulty in maintaining trained staff;
- ◆ Ineffective co-ordination between Aboriginal Fishery Officers and DFO enforcement patrols;

Managers were under increasing pressure to manage within declining budgets. Fishery Officers and others perceived this to be of greater importance to managers than conserving the fishery. By the end of the Early Stuart run, Fishery Officers in the Fraser River Division reported that patrols were down by 30 to 40 percent and the number of charges down by 70 percent

Enforcement was not only hampered by budgetary constraints and the lack of timely agreements with individual First Nations, but also by recent regulatory changes. DFO's ability to deal with the illegal sale of salmon was seriously compromised by the repeal of a prohibition on the possession of Native food fish by non-Natives.

According to many involved in the Aboriginal fishery, those AFS



- ◆ Poor accountability in terms of catch statistics, violations, seizures of gear, etc.; and
- ◆ Institutional arrangements which are alleged to have led to political peer pressures.

These events, combined with minimal direction for enforcement by various officials, added to confusion over DFO policies associated with the AFS and eventually compromised Canada's ability to conserve and protect fisheries resources in British

Columbia. The problems were, in our view, not only pervasive within the Fraser basin region but also extended to many marine regions.

The Board heard that DFO staff often were unable to respond to reports from the public, usually made over the telephone, about illegal fishing activities and habitat infractions. Given that overall compliance is dependent on achieving broad support among users and the general public, this situation must be corrected. The public should have the opportunity to call in to a

*... there is non-compliance within the recreational fishery, and indeed it will increase as it becomes known that there are fewer and fewer enforcement officers out there policing. And it is our understanding that there was not a single officer tasked with the enforcement responsibilities within the recreational fishery this past season, simply because there weren't enough officers.*

Mr. Wayne Harling, B.C. Wildlife Federation,  
December 12, 1994, Victoria

regional centre with their reports from which DFO could initiate follow-up. A 24-hour centre based on the concept of "observe, record and report" would be beneficial and could also serve as a communication centre of particular importance to enforcement officers carrying out their duties under dangerous night-time conditions.

The level of enforcement and capacity was grossly inadequate in 1994. If an adequate enforcement capacity, representing a significant deterrent to illegal fishing, is not established in 1995 and beyond, there is likely to be serious erosion of the Fraser River salmon restoration programs. Further, the increasing market value of all types of fisheries has resulted in similar enforcement issues prevailing throughout British Columbia. If permitted to continue, the attitudinal anarchy reflected in many user groups during 1994 will sooner or later destroy the fishery.

DFO must formulate a strategy and plan that will marshal the personnel, facilities, equipment and communications systems needed to re-establish a credible enforcement deterrent. The first step in the process must be a proper assessment of what is required, at a minimum, to ensure adequate enforcement. That cannot be achieved in the context of a budget exercise. Once the essential elements of an effective enforcement

system have been specified, then and only then can the authorities look to see if the available funding is sufficient. If at that time it is perceived that the existing budget cannot support adequate enforcement capacity, DFO should be prepared to reallocate priorities within the Department.

After all, the fundamental reason for the Department's existence is for the protection of the resource. To claim that enforcement cannot be achieved for budgetary reasons

*The failure of these salmon to come back in sufficient numbers to renew their abundance and add to our common wealth again and again is a reflection of the attitudes that prevail in the upper echelons of our country today. It's a product of those who wish to use the deficit-reduction mania to divest the federal government of its responsibility to administer and manage programs or responsibilities of common cultural and economic value.*

Mr. Peter McGuigan, December 14, 1994,  
Campbell River

is an abdication of the federal government's constitutional responsibility. Regardless of budgetary constraints, the future of a critical resource depends on a carefully planned and properly funded enforcement strategy. Keeping in mind the now terrible cost of compensation due to the collapse of the cod fishery, the immediate cost of enforcement and proper protection of the Pacific salmon can be seen in stark perspective.

DFO must leave no uncertainty as to its commitment to re-establish a credible enforcement level and penalize all those who abuse the law.

Violations of the law are unacceptable, and violators must be dealt with sternly. Enforcement alone cannot ensure overall compliance, however, unless there is seen to be an effective commitment to enforcement there will not be compliance.

## **RECOMMENDATIONS**

12. We recommend that enforcement be recognized once again as an essential element of the fishery management process.
13. We recommend that, for the 1995 fishing season, DFO institute a plan to ensure that an effective and credible enforcement level is re-established.
14. We recommend that DFO review the regulations pertaining to the various fisheries and implement changes needed to ensure they are enforceable.

15. We recommend that DFO undertake an in-depth investigation of 1994 abuse of fishing laws.
16. We recommend that DFO revisit its policy of non-criminal administrative sanctions (which include licence suspensions) with a view to making such a policy more workable and expanding its application.
17. We recommend that DFO establish an enforcement branch in DFO Pacific Region, headed by a director with extensive law enforcement experience, to report to the Regional Director-General and be responsible for developing and maintaining enforcement capability at a level of competence and coverage which would ensure that the Minister's mandated duty to conserve and protect Canada's Pacific fisheries resources will be fulfilled properly.
18. We recommend that DFO institute an "observe, record, report" program with a communications centre that operates 24 hours per day and seven days per week.

## **ABORIGINAL FISHERIES STRATEGY**

Hunting and fishing were the main sources of food and played a central role in the lives of the Aboriginal Peoples in Canada before the arrival of Europeans. The Fraser River basin had an abundance of salmon which, for thousands of years, British Columbia's Native people have fished, dried and smoked.

The *Fisheries Act* was proclaimed in force in British Columbia in 1876, and regulations made under the *Act* in 1878 were the first to mention Aboriginal Peoples.<sup>13</sup> These regulations provided that Aboriginal Peoples were at all times at liberty, by any means other than drift nets or spearing, to fish for food for themselves, but not for sale or barter. The Aboriginal right or liberty to fish was thereby subject to restrictions, which became more stringent over the years.

In British Columbia, Aboriginal Peoples have long been obliged to obtain commercial fishing licences and to abide by fisheries laws and regulations like other Canadians. Although little thought was given by either the federal or provincial governments to Aboriginal rights, the right of First Nations to fish for food purposes was honoured by the Crown.

In recent years, Aboriginal Peoples have been pressing for recognition of their Aboriginal rights which were mentioned but not defined in section 35(1) of the *Constitution Act, 1982*. The most significant case to date is a 1990 decision of

the Supreme Court of Canada. In the landmark case of *Regina v. Sparrow*,<sup>14</sup> the Supreme Court of Canada ruled that there is an Aboriginal right to fish, at least for food, societal and ceremonial purposes. This right is noted as being second only to conservation requirements. The Court expressly declined to consider whether there was an Aboriginal right to sell fish but determined the federal government had a duty to consult with Aboriginal Peoples to determine how their fishing rights could be satisfied while meeting conservation objectives. The Court also noted that the right to fish is a communal right, to be exercised by individual members of the community.

The issue of sale has been before the British Columbia Court of Appeal in three recent cases.<sup>15</sup> In each case, the majority of the Court held that the Aboriginal right did not include the right to sell fish. Although these decisions may be reversed by the Supreme Court of Canada, this Board is bound to accept the law as it stands now.

To address this new judicially defined priority of the Aboriginal Peoples to receive fish for food, societal and ceremonial purposes, DFO introduced the Aboriginal Fisheries Strategy (AFS) in 1992. In March 1993, a Memorandum of Understanding was signed among DFO and most of the Fraser River chiefs by which the latter agreed to co-operate on Fraser River watershed fisheries management issues. This was followed in June 1993 by the Fraser River Watershed Agreement.

In the lower Fraser River (and in two other areas outside the Fraser watershed) DFO went beyond the *Sparrow* case by setting up AFS pilot salmon sales projects which allow the commercial sale of fish that are to be landed and weighed at specified landing sites. In these pilot projects, which proceeded as a matter of policy but without any

judicial authority, food fish and commercial fish are combined in a single allocation. In all other areas in British Columbia, AFS agreements do not contain a pilot sales provision.

This inequity of rights between bands with pilot sales agreements and those without such arrangements has caused a great deal of consternation among some bands. They feel they have as much right

***For clarification it needs to be understood that there were some positive aspects of the AFS, notably some plans for enhancement, habitat improvement, and fish monitoring. However, the ill-conceived pilot sales program brought the rest into disrepute.***

Mr. Paddy Greene, Northern Representative,  
B.C. Survival Coalition, January 9, 1995, Prince Rupert

as others to sell their food fish and that they should also be given an allocation of fish to sell commercially. This has led to allegations that illegal sales are occurring, often by moving food fish into areas where commercial sales are allowed. In the long run, these inequities must be resolved, but to allow commercial sales in other areas now would simply add to the opportunity to poach like current pilot sales have done. Until

poaching is under control, there should be no extension of commercial sales to other areas.

Though we do not believe that commercial sales should be extended at present, we are convinced that all First Nation communities in the mid- and up-river areas must be involved in the overall in-river management of fish. These communities must be consulted respecting DFO's fisheries plans each year and be offered the opportunity to suggest alterations to those plans and to attend meetings in order to have input into the decision-making process, particularly with regard to escapements.

The ultimate dismay in the upper Fraser basin was that the fish came in such small numbers that some bands did not get their allocations and had to stop fishing to allow minimal escapement to the spawning grounds. This was particularly distressing in the Stuart area because it was known that there had been no commercial fishing of the

Early Stuart run. It underscores the need to involve mid- and up-river First Nation communities in the management process.

The Board was given a great deal of information regarding illegal fishing in the ocean on the sockeye runs migrating to the Fraser, particularly in the Johnstone Strait. This was reported to have occurred in two ways. The first

***The federal government should enter into long-term partnerships with First Nations and establish effective working relationships with First Nations. The present system of AFS agreements is not working.***

Mr. Ernie Crey, Sto:lo Fisheries Authority,  
December 13, 1994, Campbell River

was by seiners ostensibly fishing for Native food fish when there was no commercial opening, and selling their catch to those fish buyers who were prepared to purchase. We were told that such activity was carried out by both Native and non-Native people. The second was by seiners fishing for food fish a day or two before a commercial opening, keeping the fish on board, then fishing during a commercial opening and "laundering" the food fish by delivering them for sale as fish caught during the opening. We have been unable to determine how much illegal fishing or how much laundering of fish took place because, again, there were not enough Fishery Officers to observe or follow up on reports of offenders.

There is no question that the introduction of pilot sales under the AFS caused many problems and great consternation among other stakeholders. The cause of these concerns may not have been the program itself, but the way it was implemented. Regardless, the cumulative effects have been a lack of enthusiasm for the program by some First Nations, disappointment on the part of elders who are not getting fish for food, resentment by commercial fishers who feel some of the fish they would otherwise catch is being poached and sold illegally, and a loss of credibility on the part of

DFO. As a result, a universal attitude of "grab all the fish you can because there won't be any next year" developed, and poaching became uncontrolled. Almost every group

*I believe that if Department of Fisheries and Oceans at the highest levels continues to make policy decisions which move the management of the resource out of the hands of DFO and places it in the hands of others that in the end we will have chaos and confrontation as a result. It cannot be allowed to proceed in that manner.*

Mr. Mike Scott, MP, (Skeena), January 9, 1995, Prince Rupert

that appeared before the Board, Native and non-Native, commercial and recreational, admitted that members of their group had been guilty of poaching.

The AFS must be understood and interpreted in light of the social circumstances of the First Nations in Canada. The food fish portion of the strategy is a recognition of the effect of section 35(1) of the *Constitution Act* as interpreted in *Sparrow*. The pilot sales are a crea-

ture of federal government policy. Several persons appearing before us pointed out that there were no problems of "missing" fish before these programs were implemented and suggested that the solution was to abolish the pilot sales.

*The constitutional entitlement embodied in 35(1) requires the Crown to ensure that its regulations are in keeping with ... [the priority which Indian food fishing is to be given over the interests of other user groups]. The object of this requirement is not to undermine Parliament's ability and responsibility with respect to creating and administering overall conservation and management plans regarding the salmon fishery. The objective is rather to guarantee that those plans treat aboriginal peoples in a way ensuring that their rights are taken seriously. (emphasis added)*

*Regina v. Sparrow* (1990), 70 D.L.R. (4th) 385 at 416,  
Chief Justice Dickson and Mr. Justice LaForest

But turning back could easily lead to a more contentious and corrosive situation than prevailed in 1994. The unresolved questions of First Nation land claims and sharing of natural resources are among the most important political issues in British Columbia today. These have serious long-term consequences on our social fabric and the economic well-being of British Columbians, with much of our wealth still dependent on the exploitation of natural resources. Reaching social harmony and justice for First Nations and other Canadians must rank as an important long-term goal for British Columbia.

It is, of course, the pilot sales which have been most soundly

assailed. The most strident objections are based on fear of losing a share of the available



catch. This is real, and based on a sound assessment of what may well come. But the fishing resource does not belong to any one group of Canadians. It belongs to us all, whether Native or non-Native. There is a widespread general feeling that Aboriginal Peoples have not been fairly treated. The AFS pilot sales seek to give them a larger share of the resource, but the program was implemented without being fully thought through.

Every effort must be made to make the AFS work. In each of the three years that the AFS has been in effect, the late signing of some agreements may have provided the opportunity for increased poaching. Ultimately, whether or not agreements are in place, it is only the First Nations who will be able to prove, through accurate catch accounting, that poaching has come to a halt. Although there is scepticism about Aboriginal Fishery Officers policing their own, in the long run, with proper training and institutional arrangements, we believe these officers can provide the same level of enforcement as Fishery Officers and play a large part in eliminating poaching.

Mindful of the *Sparrow* decision, DFO must negotiate with First Nations on the basis of mutual respect, always considering traditional Native rights and customs. Consultation and co-operation among First Nations should be facilitated through the watershed process and in other ways. However, DFO has no right to transfer Canada's constitutional responsibilities to protect the resource to anyone, Native or otherwise. This responsibility must be retained always by the Government of Canada.

## **RECOMMENDATIONS**

19. We recommend that DFO ensure that AFS agreements clearly identify the Minister's responsibility for conservation, and that final authority to regulate and protect fish and fish habitats remains vested in DFO.
20. We recommend that DFO expedite the implementation of an effective training program to develop fisheries management, enforcement and administrative capacity within First Nation communities.
21. We recommend that DFO, in consultation with First Nations, separate food and commercial fish in time and space to promote more effective enforcement.
22. We recommend that all AFS agreements contain a dispute resolution mechanism and, when feasible, be cast within multi-year frameworks.
23. We recommend that the pilot sales project not be expanded at present.

24. We recommend that, in those AFS agreements having a pilot sales component:
- no sale of fish or payments to First Nations for AFS purposes be permitted until agreements are completed and signed;
  - the agreements specify that DFO Fishery Officers and Aboriginal Fishery Officers be responsible to and directed by a DFO official;
  - landing sites be clearly identified;
  - the agreements require that fish landings and the sale of fish be documented; and
  - any sale of fish other than that recorded and documented at a designated landing station be deemed to be an illegal sale.
25. We recommend that, in First Nation territories where there are no AFS agreements, DFO implement plans to improve the quality of catch estimates.
26. We recommend that DFO pursue a policy of purchasing licences in the commercial sector and transferring these to First Nation communities, not for traditional Aboriginal fisheries, but to increase their participation in established commercial fisheries in a manner consistent with the laws and regulations pertaining thereto.

## **THE ENVIRONMENT**

Sockeye start their life as eggs in the gravel of river beds; they spend their first year of life in lakes, use rivers to move from one habitat to the other, and grow to maturity in the ocean. The quality of each one of these habitats is critical to the life of the fish and already a concern to DFO's Habitat Protection Branch.

Three physical features of the environment are singled out as critical: open-ocean conditions; river water temperatures and flow rates; and water quality.<sup>16</sup> These will be described in general terms before we deal with 1994 conditions.

Ocean conditions affect the success of the sockeye's life at sea; food availability affect their growth rate, water temperatures and currents affect their migration routes. Inter-annual variability in these conditions will determine net survival at sea, weight at maturity and the details of run timing and the diversion rates in ways which are still a matter of active research. Warm water conditions off the B.C. coast are thought to increase the diversion rate, forcing salmon to avoid warm offshore waters in favour of the cooler waters of Johnstone Strait. In 1992 and 1993, high water temperatures were associated with El Niño. Although there was no El Niño in 1994, warm ocean temperatures persisted.



The strongest oceanic influence on the 1994 sockeye runs was clearly the very high (at times over 90 percent) diversion rate north of Vancouver Island. Pre-season esti-

*... it takes a long time for the ocean to lose heat ... if you have a coffee cup of hot water... it is going to cool off ... in five or 10 minutes ... a bathtub [in] maybe 20 [or] 30 minutes ... [but] the ocean can't lose that heat very rapidly.*

Dr. Howard Freeland, Institute of Ocean Sciences, Department of Fisheries and Oceans, December 12, 1994, Victoria

mates based on available ocean temperatures suggested that only 65 to 68 percent of the sockeye would move southward through Johnstone Strait. This underestimation resulted in considerable fleet movement and in-season adjustment of fishing plans. It is clear that a reliable method of predicting the diversion rate is still not available, in spite of many years of research effort. In view of its importance to

management strategy and assessment reliability, further efforts must be devoted to understanding the relation between diversion rate and environmental conditions on a stock-by-stock basis.

Whether warmer coastal ocean temperatures are related to some global warming phenomenon or to local variability is of interest for long-term planning, as are considerations of the capacity of the Northeast Pacific for rearing sockeye. Nevertheless, the diversion rate question merits the highest priority.

Water quality in rearing-lakes and river migration routes is important at the fry stage of sockeye life and during spawning migration. Habitat protection remains a long-

*... we are at a stage now in terms of fish habitat and water quality issues where there really isn't much give any more. We don't need to start mitigating for new stresses. We need to recognize that we have so many stresses right now in terms of the fish habitat and water quality issues that we really must start taking a zero tolerance line.*

Ms. Mae Burrows, T.Buck Suzuki Environmental Foundation, November 29, 1994, Vancouver

term important concern for the sustainability of the resource. Although no unusual water quality issues were identified for the 1994 season, specific high-level pollution from identifiable sources, especially industrial and municipal outfalls, must be eliminated as much as possible. In this respect, the Greater Vancouver Regional District's Annacis Island outfall has been identified as potentially harmful to migrating salmon. The Board recognizes the importance of com-

pleting a secondary treatment facility for this outfall to maintain water quality in the lower Fraser River.

The most crucial and controversial environmental feature identified with sockeye migration is water temperature in the Fraser River and its tributaries. Sockeye will not survive in temperatures above 21.5°C, and their energy requirements increase rapidly with temperatures above 15°C. Sockeye must also spend energy fighting currents in their upstream migration, so that higher discharge rates may also impede their progress. River conditions are thus crucial for successful migration — fish must have sufficient energy to reach their spawning grounds. If they exhaust their energy reserves, they die, either en route or before spawning. The question of mortality during the river migration and on the spawning grounds has long been an important concern.

Water temperatures in the Fraser River were high in 1994. Values approaching 20°C were reached in the main stem of the Fraser and some of its tributaries (for example, the Nechako River). Mortality caused by high temperatures was a major concern

***The Fraser is still remarkably forgiving of the abuse we've heaped upon it. We can be confident of its forgiveness if we act now. But this opportunity will not always be there.***

Mr. Ian Waddell, Chair of the Board, Fraser Basin Management Program, November 29, 1994, Vancouver

in 1994; one of the DFO Technical Working Group reports addressed this and other in-river mortality causes and suggested an en-route mortality approaching half a million fish. However, the estimate is highly speculative.

The inability to estimate in-river mortality remains a management deficiency which may strongly

affect conservation objectives. The lack of a predictive model of river water temperatures has made it impossible to take, in advance, precautionary steps in the management of the fishery, but the estimated 1994 in-river losses suggest that this risk must be accounted for in management decisions.

Finally, there is an overarching matter of policy regarding the environment of the Fraser River basin. If this basin is to be maintained as an area devoted to the rearing of salmon for future generations, consistent protection must be applied to it. Water quality must be maintained; effluents must be properly regulated; water temperatures must be kept at a level tolerable to migrating fish; and, generally, all obstacles inhibiting continuing use of the river and its tributaries and headwaters as salmon-rearing habitats must be removed. The *Fisheries Act* already provides for much of that protection. There is a need to reiterate the policy of environmental protection for the Fraser River basin because it does affect action taken to protect the sustainability of the salmon resource.

Over the years, obstacles due to physical impediments and high currents have been removed by construction of appropriate fish ladders. Part of the reconstruction of Fraser River sockeye runs following the creation of the International Pacific Salmon Fisheries Commission has been due to this proactive response to environmental

conditions. If the Fraser River basin is to be maintained as a sustainable salmon-rearing area, similar action should be taken with respect to control of water temperatures. Such actions may include a number of facets: careful land use and forestry practices to prevent rapid warming of precipitation flowing to the river basin; maintenance of flow rates sufficient to keep temperatures low in conditions when such a factor is critical; proactive cooling of most critical rivers by hydraulic works; and the draining of cold water from available lakes. The cost of such actions should be considered in light of the value of the resource and in comparison with that of structures, such as fish ladders, which have dealt with other obstacles to up-river migration.

We note the longstanding and bitter dispute over the Kemano Completion Project. The B.C. government, having considered the British Columbia Utilities Commission report,<sup>17</sup> has rejected the Kemano Completion Project as contemplated by the 1987 agreement concluded between Alcan and the governments of Canada and British Columbia. It should be clearly understood that there is, in fact, a dam on the Nechako River and that cancellation of the Kemano Completion Project does not restore original river conditions. To what degree arrangements can be made at the dam site to restore river conditions for salmon stocks remains to be seen, and we have not been asked to solve that serious problem. However, no further impediments or diversions should be constructed on the Fraser River or streams and tributaries within its watershed without the most careful and complete environmental assessment.

## **RECOMMENDATIONS**

27. We recommend that DFO urge the Greater Vancouver Regional District and the province of British Columbia to install, without further delay, at Annacis Island the secondary sewage treatment facility which has long been under consideration.
28. We recommend that DFO develop a predictive water temperature model, supported by adequate observation systems, for the Fraser River and its major sockeye tributaries. Information on water temperatures should be used for in-season risk aversion management.
29. We recommend that federal, provincial and local governments join forces to develop effective policies and plans in the Fraser River basin designed to:
  - Better treat and control the discharge of effluent into the Fraser River watershed;

- See to the implementation of responsible forestry practices in line with the new provincial Forest Practices Code;
  - Continue to remove in-river obstacles which impede the migration and spawning of anadromous species; and
  - Regulate urban development in the Fraser River watershed so as to be compatible with environmental priorities.
30. We recommend that DFO conduct further research on:
- The effects of logging on the water temperature and flow regime in the Fraser River;
  - Means by which to mitigate adverse water temperature and flow fluctuations;
  - The effect of multiple, sublethal stresses on migrating salmon;
  - Means by which to improve anadromous species survival at all stages of the life cycle in the face of natural fluctuations and predation;
  - Environmental effects on the Johnstone Strait diversion rate; and
  - Such matters as the potential of gene banking and altered fishing techniques as means by which to promote the enhancement of anadromous species' genetic diversity.

## **USER GROUP VIEWS AND RESPONSIBILITIES**

As might be expected, user group and other public commentary views were at times diverse and conflicting and at other times conveyed a common theme.

Universal support for the basic tenets of conservation and rebuilding the Fraser River salmon runs was expressed by almost all intervenors. Differences arose, however, over what should be done to accomplish these important goals, who should be responsible for ensuring that conservation goals were met, and how the surplus production over that required for conservation should be allocated among user groups.

Among recreational and commercial fishers there was widespread sentiment that the in-river Native sales program component of the AFS was a failure and could lead to the destruction of the Fraser River salmon run. Most, however, were not critical of other elements of the AFS. Commercial fishing groups did not believe that in-river catches and sales activity could be properly monitored. They were also convinced that illegal fishing activities played a role in the estimates of run size in the Johnstone Strait and in the "missing" in-river fish. Fishers and processors felt that lack of enforcement and the inability to track the fish once they had landed fostered excessive illegal activity.

Conservation groups were more inclined to point to excessive marine fishing capacity, the need for more selective fishing methodologies and habitat destruction.

*I think that there are many people in the industry, including the Minister, who have recognized that — not just the power of the fleet in its physical terms but the economic implications of having that many units of capital out there is probably not the most efficient way to do business. And I think that the industry will find or have imposed upon it a solution for the next few years to that problem.*

Mr. Mike Hunter, Fisheries Council of B.C.,  
November 29, 1994, Vancouver

the result of poor run size estimation and in-river environmental problems. From their vantage point, management should start from the escapement and Native catch needs

*As long as the predominant motivating factor is short-term profit, we will continue to witness the overharvesting of stocks and a decline in biodiversity. We have to make the shift not to sustainable development — that is, sustaining the current levels of development in the industry — but developing sustainability.*

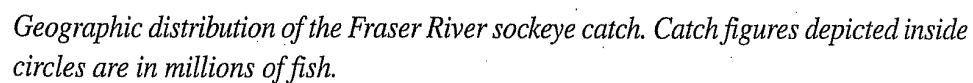
Ms. Catherine Stewart, Greenpeace Canada,  
November 29, 1994, Vancouver

should play an equal partnership role in management of the Fraser aquatic living resources.

They too, however, were concerned over the enforcement of existing law. Further, they pointed to the need for a more holistic and ecosystem-oriented management perspective. Great concern was expressed for preserving the complex mix of anadromous and resident fish stocks of the Fraser River system.

First Nation peoples were equally concerned with conservation of the resource but saw a great management disaster in the extensive marine commercial fishery. "Missing fish" were believed to be

up-river and flow down-river and then to the marine harvest requirements. Of course, under current Canadian law that order of priority prevails. They also noted that although illegal fishing was a problem in some in-river regions, the potential problem of illegal fishing in the marine environment was substantially larger. Most First Nations spoke of the great need to protect the watershed habitat and felt that First Nation peoples





DFO in many respects is caught between the proverbial rock and a hard place. Its staff have wide and onerous responsibilities to carry out important national commitments for the conservation of resources and habitat maintenance.

*When are we going to look at the responsibility that we have towards the resource in a holistic way? It cannot be compartmentalized into one little area. You cannot say that the review of the management of the fishery on the west coast can only be done in the Fraser River because those Aboriginal People are abusing and taking all of the fish .... I hope that your Board takes that message ... and recommends to the Department of Fisheries to open up their eyes, their ears, and most importantly, to open up their souls to what their responsibility is here.*

Ms. Wendy Grant, Aboriginal Fisheries Commission,  
November 23, 1994, Vancouver

The government austerity restraint program, as implemented by DFO in British Columbia, has eroded its capacity to carry out this important stewardship mandate. Since the fiscal situation is likely to prevail for some years, DFO must examine alternative approaches to do more with less. This includes clear-headed selection of priorities within its mandate. The growing management needs of DFO cannot be effectively achieved without the committed support and co-operation of the user groups.

The Board thus urges the relevant users of the resources to examine ways and means to support DFO's mission. DFO's role would involve early implementation of co-management strategies. Industry should formulate and support improved methods for verifying catch records and speeding up the transmission of such information to DFO.

*In terms of the revenue and the economics, we believe that recreational fishermen would pay, gladly pay for the opportunity to catch fish if they were here.*

Mr. John Carter, Freshwater Chair, B.C. Wildlife  
Federation, January 20, 1995, Kamloops

Industry and recreational groups should consider a peer process to assist government in surveillance and monitoring. First Nation peoples should work with DFO to improve the quality of catch records and to improve enforcement for in-river sectors.

*We believe that the most important thing before us is to maintain our public commitment to the resource, and that means seeing the cost of managing, the cost of protecting, the cost of enhancing those fish as an investment and not a cost.*

Mr. Dennis Brown, United Fishermen and Allied Workers' Union, November 29, 1994, Vancouver

Improved management will require the efforts of all concerned user groups, including those individuals without direct economic interest. Without the help of the user groups and other stakeholders, the quality of information needed for efficient management of the resources will continue to deteriorate, and the need for more and more conservative management will increase.

## **RECOMMENDATIONS**

31. We recommend that industry participants in the salmon fishery develop and implement in conjunction with DFO a self-sustaining, user-pay, landing verification system, as already exists in other West Coast fisheries (for example, halibut, sablefish and groundfish).
32. We recommend that industry participants in the salmon fishery develop and implement, in conjunction with DFO, a peer group system for reporting to DFO, the illegal catch, sale and transportation of fish.
33. We recommend that industry participants in the salmon fishery and DFO work together to investigate means of dealing with excessive fishing capacity.
34. We recommend that a user fee be assessed on fishers and processors to increase funding available to DFO, if it can be assured that all monies collected will be used only for local fisheries management.
35. We recommend that, in the interest of conservation, DFO ban monofilament nets, gaffing and other fishing gear which may be wasteful of the resources harvested.



## NOTES

1. Pearse, *Managing Salmon in the Fraser*, *op. cit.*, Chapter One, note 8.
2. *Ibid.*, p. 29.
3. *Ibid.*, p. 3.
4. *Fraser River Sockeye Management and Enhancement Plan: Summary Report* prepared by DFO's Fraser River Sockeye Task Force for Area Planning Committee, Fraser River, Northern B.C. and Yukon Division, December 1988.
5. November 1, 1994 DFO computer analysis of total Canadian and U.S. catches confirmed by PSC as the most up-to-date catch figures available as at February 9, 1995.
6. January 9, 1995 DFO computer analysis of in-season and post-season estimates of purse seine catch in Johnstone Strait presented at February 2, 1995 PSC workshop.
7. *Chronology of 1994 Events* prepared by DFO for the Board.
8. *Op. cit.* Chapter Two, note 5.
9. The Panel is composed of DFO managerial and technical staff and representatives from First Nations, commercial and recreational fishing sectors. Although there were two positions for Aboriginal members, only one representative generally participated. In 1994, membership was considerably expanded, and the Panel had an open-door policy for interested observers.
10. Services provided by PSC staff include in-season collection and analysis of data from Canadian and American commercial landing sites and test fisheries and the Mission hydroacoustic station. From this information, PSC staff also provides crucial in-season forecasts of stock abundances and run timing.
11. This Agreement was first signed in 1993 and revised in 1994.
12. North of Cape Caution, the North Coast Area Manager is responsible. South of Cape Caution (including both coasts of Vancouver Island), the South Coast Area Manager has jurisdiction. The southern Georgia Strait and the Fraser estuary and watershed are the responsibility of the Fraser River Area Manager.
13. *Salmon Fishery Regulations for British Columbia*, 1878.
14. *Regina v. Sparrow* (1990), 70 D.L.R. (4th) 385 (S.C.C.).
15. *Regina v. Van de Peet*, [1993] 5 W.W.R. 459 (B.C.C.A.); *R. v. Gladstone*, [1993] 5 W.W.R. 517 (B.C.C.A.); *R. v. N.T.C. Smokehouse Ltd.*, [1993] 5 W.W.R. 542 (B.C.C.A.)

*The Board's Findings*

16. As well, concern was expressed to the Board by a number of persons relating to the apparent increase of seals and sea lions on the west coast thereby raising questions about their effect on salmon stocks and especially lesser stocks in small streams. While the Board recognizes this concern there was no suggestion that there was an immediate impact on sockeye stocks however it is something that probably merits further study.
17. *Kemano Completion Project Review: Report and Recommendations to the Lieutenant Governor in Council*, December 1994.

# *Summary of Recommendations*

## **MANAGEMENT**

### ***Risk Aversion Management***

1. We recommend that DFO retain and exercise its constitutional conservation responsibilities and not in any way abrogate its stewardship of resources under federal jurisdiction. Conservation must be the primary objective of both fisheries managers and all others participating in the fishery. The conservation ethic must prevail throughout and be adhered to by all.
2. We recommend that DFO take immediate steps to initiate a process of planning for the future of the fishery, addressing all critical problems affecting conservation and sustainability, through an ongoing consultative forum. Among the problems to be considered would be over-capitalization, user-group allocation and ensuring equitable treatment under the law.
3. We recommend that DFO and PSC adopt a risk aversion management strategy because of the great uncertainty in stock estimates, in-season catch estimates and environmental problems. Conservation goals must be achieved before any other priorities are addressed.
4. We recommend that DFO, in conjunction with provincial authorities, First Nations, commercial and recreational fishery groups, implement (both in marine and in-river areas) a revised system to ensure that catch information is timely and reliable, given that accurate counting and timely reporting of catch are fundamental to conservation. The system must also include a more stringent paper trail wherein there must be stricter control of landing and sales slips and a mandatory retention of sales slips with fish through to retail sale or export.

5. We recommend that DFO explore the application of new technology to collect information on stock levels in ocean areas in order to supplement catch statistics.

### ***Institutional Arrangements***

6. We recommend that DFO develop better co-ordinated inter-party communications among its staff and between its staff and PSC, First Nations, commercial and recreational fishing groups, with a greater degree of co-operation aimed at enhanced in-season management and post-season evaluation and at fostering closer working arrangements among all parties, and facilitate clearer and more transparent management and allocation policies.
7. We recommend that DFO and PSC give First Nations greater and more meaningful access to, and involvement in, the management process.
8. We recommend that DFO, PSC, First Nations and user groups institute a formalized pre-season review of each season's management plans and strategies, to be followed by a post-season performance analysis. Independent experts should be invited to assist in extending the range of expertise and in promoting transparency in the management process.
9. We recommend that the Canadian section of the Fraser River Panel be vested with responsibility for in-season management for Fraser River sockeye and pink salmon fisheries in Canadian waters beyond the current PSC Convention area. Further, to facilitate communication and understanding (between DFO and PSC) of the in-season run and stock size estimates, a member of the DFO Stock Assessment Division be assigned to work closely with PSC during planning, estimation and evolution of run estimating procedures. There is also a need for practical arrangements for in-season communications between the U.S. and Canadian sides of the Fraser River Panel, whether or not there is formal diplomatic agreement.
10. We recommend that an independent Pacific Fisheries Conservation Council be established to act as a public watchdog for the fishery, to report to ministers and the public annually and from time to time as is appropriate.

### **Quality Management Principles**

11. We recommend that DFO make a commitment to quality management principles in the management of fish stocks by Pacific Region and, in this context, that a third-party quality auditing organization be contracted to provide ongoing services.

### **ENFORCEMENT**

12. We recommend that enforcement be recognized once again as an essential element of the fishery management process.
13. We recommend that, for the 1995 fishing season, DFO institute a plan to ensure that an effective and credible enforcement level is re-established.
14. We recommend that DFO review the regulations pertaining to the various fisheries and implement changes needed to ensure they are enforceable.
15. We recommend that DFO undertake an in-depth investigation of 1994 abuse of fishing laws.
16. We recommend that DFO revisit its policy of non-criminal administrative sanctions (which include licence suspensions) with a view to making such a policy more workable and expanding its application.
17. We recommend that DFO establish an enforcement branch in DFO Pacific Region, headed by a director with extensive law enforcement experience, to report to the Regional Director-General and be responsible for developing and maintaining enforcement capability at a level of competence and coverage which would ensure that the Minister's mandated duty to conserve and protect Canada's Pacific fisheries resources will be fulfilled properly.
18. We recommend that DFO institute an "observe, record, report" program with a communications centre that operates 24 hours per day and seven days per week.

## **ABORIGINAL FISHERIES STRATEGY**

19. We recommend that DFO ensure that AFS agreements clearly identify the Minister's responsibility for conservation, and that final authority to regulate and protect fish and fish habitats remains vested in DFO.
20. We recommend that DFO expedite the implementation of an effective training program to develop fisheries management, enforcement and administrative capacity within First Nation communities.
21. We recommend that DFO, in consultation with First Nations, separate food and commercial fish in time and space to promote more effective enforcement.
22. We recommend that all AFS agreements contain a dispute resolution mechanism and, when feasible, be cast within multi-year frameworks.
23. We recommend that the pilot sales project not be expanded at present.
24. We recommend that, in those AFS agreements having a pilot sales component:
  - no sale of fish or payments to First Nations for AFS purposes be permitted until agreements are completed and signed;
  - the agreements specify that DFO Fishery Officers and Aboriginal Fishery Officers be responsible to and directed by a DFO official;
  - landing sites be clearly identified;
  - the agreements require that fish landings and the sale of fish be documented; and
  - any sale of fish other than that recorded and documented at a designated landing station be deemed to be an illegal sale.
25. We recommend that, in First Nation territories where there are no AFS agreements, DFO implement plans to improve the quality of catch estimates.
26. We recommend that DFO pursue a policy of purchasing licences in the commercial sector and transferring these to First Nation communities, not for traditional Aboriginal fisheries, but to increase their participation in established commercial fisheries in a manner consistent with the laws and regulations pertaining thereto.

## **THE ENVIRONMENT**

27. We recommend that DFO urge the Greater Vancouver Regional District and the province of British Columbia to install, without further delay, at Annacis Island the secondary sewage treatment facility which has long been under consideration.
28. We recommend that DFO develop a predictive water temperature model, supported by adequate observation systems, for the Fraser River and its major sockeye tributaries. Information on water temperatures should be used for in-season risk aversion management.
29. We recommend that federal, provincial and local governments join forces to develop effective policies and plans in the Fraser River basin designed to:
  - Better treat and control the discharge of effluent into the Fraser River watershed;
  - See to the implementation of responsible forestry practices in line with the new provincial Forest Practices Code;
  - Continue to remove in-river obstacles which impede the migration and spawning of anadromous species; and
  - Regulate urban development in the Fraser River watershed so as to be compatible with environmental priorities.
30. We recommend that DFO conduct further research on:
  - The effects of logging on the water temperature and flow regime in the Fraser River;
  - Means by which to mitigate adverse water temperature and flow fluctuations;
  - The effect of multiple, sublethal stresses on migrating salmon;
  - Means by which to improve anadromous species survival at all stages of the life cycle in the face of natural fluctuations and predation;
  - Environmental effects on the Johnstone Strait diversion rate; and
  - Such matters as the potential of gene banking and altered fishing techniques as means by which to promote the enhancement of anadromous species' genetic diversity.

## **USER GROUP VIEWS AND RESPONSIBILITIES**

31. We recommend that industry participants in the salmon fishery develop and implement in conjunction with DFO a self-sustaining, user-pay, landing verification system, as already exists in other West Coast fisheries (for example, halibut, sablefish and groundfish).
32. We recommend that industry participants in the salmon fishery develop and implement, in conjunction with DFO, a peer group system for reporting to DFO, the illegal catch, sale and transportation of fish.
33. We recommend that industry participants in the salmon fishery and DFO work together to investigate means of dealing with excessive fishing capacity.
34. We recommend that a user fee be assessed on fishers and processors to increase funding available to DFO, if it can be assured that all monies collected will be used only for local fisheries management.
35. We recommend that, in the interest of conservation, DFO ban monofilament nets, gaffing and other fishing gear which may be wasteful of the resources harvested.



# *Technical Appendices*

## **1. REPORT OF THE MISSION HYDROACOUSTIC FACILITY WORKING GROUP**

### **Report Summary**

The *Report of the Mission Hydroacoustic Facility Working Group* provides an assessment of the Pacific Salmon Commission's hydroacoustic facility for estimating salmon escapements at Mission, B.C. It focusses on two aspects: bias potential in the estimates of total escapement, and a comparison of Mission and other in-river estimates.

The Report is particularly thorough in identifying key sources of bias. It concludes that although the potential biases raise some concerns, these are unlikely to lead to serious errors in escapement estimation. The correlation between Mission and up-river estimates, including the experimental DFO facility at Qualark Creek, is cited as supporting evidence.

The Report concludes with recommendations stating that the present procedures should not be drastically altered, but that effort be directed at validating and improving the methodology. Specific reference was directly made to using split-beam echo sounding to evaluate fish speed and direction, and supplementing the existing paper recording system with magnetic tape.

### **Board Commentary**

We concur with the main conclusions and recommendations of the Report. We understand that a further co-operative effort between DFO and PSC staff has been organized to put these recommendations into practice. This initiative will greatly enhance the effectiveness of both groups' echo sounding programs. Not only will the combined program be better co-ordinated, but the base of expertise to work on each component will be expanded. We strongly endorse this development and urge that individuals with pertinent expertise be added to the project where appropriate. Also PSC staff should continue their efforts to improve their stock discrimination and pink salmon estimation programs.

### **Sources of Bias in Mission Estimates**

Sources of bias in Mission estimates can be either positive or negative. Positive biases promote overly large estimates, and hence provide false evidence of missing fish in the river. Negative biases cause the estimates to be too small, leading the unwary to conclude that fish had miraculously appeared in the river without having passed the Mission counter.

From the analysis below, it can be concluded that overall there is a potential for positive bias of around 20 percent or more, and a potential for negative bias of unknown magnitude.

### **Sources of Positive Bias**

1. **Fish Travel Speed.** The estimation formula assumes that the boat is travelling much faster than the fish. This is not the case, and the resulting positive bias has been estimated at around 11 percent to 15 percent.
2. **Fish Swimming Direction.** The formula assumes that fish are swimming directly up-river. Although the Mission site was chosen with care to minimize problems with this assumption, it will clearly be violated to some extent. If the swimming direction were to depart from the upstream direction by an average of  $10^\circ$ , this would contribute a positive bias of around 3 percent. Milling, i.e., circling up and down past the study site, has the potential to produce large, positive biases, but no extraordinary evidence of milling was discovered in 1994.
3. **Estimation Formula.** A new estimation formula has been introduced on an experimental basis to account for technical sources of bias in the mathematical underpinnings. In the two years that it has been in use, this has pointed to a 6 percent positive bias from the old formula.
4. **Stock Discrimination.** Fish scale analyses are used in-season to discriminate among major stock groups. It is believed that the procedure tends to overestimate the abundance of smaller groups and to underestimate the larger ones. The relative error will be larger for the smaller groups for which there may then be a noticeable positive bias.

### **Sources of Negative Bias**

1. **Multiple Targets.** If two or more fish are at the same distance from the echo sounder, only one target will show up. This will lead to an undercount. It is thought that sockeye densities are rarely large enough to make this bias large.

2. **Detection problems near the beam edge.** These can be shown to produce a small, negative bias.
3. **Fish near the bottom, the surface and river banks.** Fish within about 60 to 100 centimetres of the river bottom will not likely be detected by the Mission counter. This produces a negative bias of unknown size. Since the equipment cannot detect these fish, we cannot tell how many are missed without supplementary observations from some other source. Fish near the surface and river banks will also go undetected — a potentially major source of bias for pink salmon.
4. **Avoidance of boat.** If fish avoid the boat, fewer will be detected, and the estimate will be too small.

## **2. REPORT OF THE IN-RIVER CATCH ESTIMATION WORKING GROUP**

### **Report Summary**

This Report presents a detailed analysis of the 1994 in-river catch data and associated evidence of unreported, misreported and illegal catch. After an extensive review of the evidence relating to unreported catch, the Working Group developed estimates of reported and unreported catch for each major identifiable group in the river.

The Report cautions, however, that the accuracy and precision of the revised catch estimates are unknown, citing the following reasons: (1) only a small percentage of the additional catch is attributable to obvious errors that were detected in post-season reviews; (2) most of the additional catch results are from extrapolations of original catch estimates, based on limited data for a few areas; (3) no formal programs were implemented in 1994 to evaluate the quality of the data collection or catch estimation programs; and (4) no data are available to estimate illegal catch because enforcement programs are designed to detect and deter illegal fishing activity rather than quantify the illegal catch.

The Working Group Report concludes that in-season catch estimates for several key areas and times were inadequate to ensure that conservation objectives were met. In discussing reasons for this failure, the Report highlights lack of clearly defined objectives for catch estimation programs; difficulty in designing and implementing technically rigorous programs; inadequate supervision and training of catch monitors; inadequate interactions between DFO and First Nations regarding program design and evaluation and data sharing; inadequate and untimely provision of resources for catch estimation programs; and lack of any programs specifically designed to quantify illegal catch or measure compliance with mandatory landing programs.

The Working Group determined that the enforcement data which were provided to them suggested no dramatic increase in illegal fishing in 1994.

The Report outlines the following steps to help improve catch estimates in Fraser River fisheries: (1) Design and implement programs to produce defensible catch estimates in the area from Sawmill Creek to Kelly Creek; (2) Design and implement programs to produce defensible estimates of illegal catches in the Fraser River; (3) Design and implement a program to estimate compliance with the Mandatory Landing Program that produces defensible estimates of unlanded catch; (4) Design and implement a program to estimate unreported catch in the Area 29 "A" licence commercial fishery; and (5) Design and implement a creel survey to estimate recreational fish catches in the Fraser River downstream of the confluence of the Coquihalla River.

The Report makes recommendations in four specific areas. In the area of technical issues for First Nations fisheries with mandatory landing programs, the Working Group recommends that contingency programs be put in place if agreements are not reached. It is further recommended that all First Nations share data and implement defensible catch estimation programs. The Working Group recommends that the commercial and recreational fisheries implement a program to estimate unreported catch in Area 29 of the commercial fishery and that a creel survey be implemented for the in-river recreational fishery. Recommendations in other areas include the establishment of a Fraser River fisheries management working group, the establishment of a joint DFO-First Nations technical process, and the development of enforcement protocols with all Fraser River watershed First Nations.

### **Board Commentary**

The Board values the dedicated effort of this Working Group in assessing the size of the unreported catch. We agree that the accuracy and precision of the catch estimates cannot be determined and that without such information DFO's ability to conserve the stocks has been compromised. The problem must be corrected. To this end, we endorse the thorough technical recommendations of the Working Group, and concur that a high priority should be assigned to improvements of existing proceedings below Sawmill Creek and to reaching comprehensive agreements with the Nlaka'pamux Nation Tribal Council and Stl'atl'imx Nation.

The Board urges the creation of a single responsibility centre for in-river catch estimation, which would perform the following functions:

1. Develop and continually update a comprehensive plan for catch estimation through consultation and negotiation with fishing groups, enforcement staff, fish management workers and biostatisticians;

2. Advise DFO management of the cost of achieving the goals for the catch estimation program, and of the consequences of a shortfall in funding;
3. Establish and maintain a central, publicly accessible set of procedural manuals;
4. Establish and maintain a central, publicly accessible data base for catch estimates;
5. Participate in consultations and negotiations with stakeholders to ensure that agreements will lead to defensible catch estimates; and
6. Liaise with the proposed Pacific Fisheries Conservation Council on biostatistical reviews of the catch-estimation program.

The catch estimation centre should use individuals with strong theoretical backgrounds and field experience in all areas related to catch estimation, including enforcement, electronic data transfer and biostatistical theory.

### **3. REPORT OF THE EN-ROUTE MORTALITY WORKING GROUP**

#### **Report Summary**

This Report examines the possible effects of environmental conditions on sockeye salmon in the Fraser River during the 1994 spawning migration. The Report concludes that there was significant en-route mortality in 1994 and that up to 15 percent of the fish which entered the Fraser River, or approximately 466,000 fish, died before reaching the spawning grounds.

Prespawning mortality was observed to be higher in 1994 than in 1993, but it was not anomalously high for any of the stocks examined. There were no in-river physical obstructions to migration in 1994, and only a few sockeye carcasses were observed in the Fraser River. Since there are no direct measures of in-river mortality, the report reviews the known handicaps to sockeye migration such as high temperature and streamflow which could be indicative of high levels of en-route mortality.

In 1994 water temperatures in the Fraser basin were abnormally high. In late July and August of 1994 the water temperatures in the Fraser River at Hells Gate were high with the average temperature for the month of July being the second hottest on record at 17.7°C. During a few days in late July the water temperatures were the highest recorded since 1942 (compared with the long-term average for July of 15.7°C).

Once past the main stem of the Fraser, the Early Stuart sockeye continued to experience high water temperatures encountering temperatures averaging 20.3°C during their passage through the Nechako and Stuart rivers. The Early Summer and Summer stock groups also encountered high temperatures during August in the Fraser River, with

the temperature averaging 19.1°C during their migration (compared to a long-term average of 16.9°C).

In-river streamflow at Hope from June through September was generally lower than the long-term average. However, streamflows in July were higher than previous high temperature years such as 1958, 1961, 1979 and 1992. It is this combination of high temperatures and relatively high streamflow which takes its toll on the energy of the migrating sockeye.

Bioenergetic modelling for migrating Early Stuart sockeye indicated that energy use in 1994 was the third highest since 1961, exceeded slightly by 1975 and 1976. An analysis of past years with negative discrepancies between upstream and Mission estimates of abundance for Early Stuart sockeye (with 1992 and 1993 excluded) indicated that energy consumption was significantly greater than in years with no significant discrepancy. This is consistent with the hypothesis that energy depletion is a significant source of en-route mortality for Early Stuart sockeye.

The Report concludes that 1994 was a more difficult year for migration than 1992 when Dr. P. Larkin estimated that 10 percent of Fraser River sockeye died en route to the spawning grounds. The Working Group concludes that up to 15 percent, or approximately 466,000 fish, entering the Fraser River, died before reaching their spawning grounds.

The Report recommends that one or two sites be established in the environmental monitoring program which are capable of transmitting environmental data on a timely basis to aid in management decisions; that timely Fraser River temperature and streamflow data be provided to fishery managers to allow for in-season adjustments in escapement targets in years with adverse environmental conditions; and that an action plan be established for gathering detailed physiological data during times of difficult passage, so that more precise estimates of environmental limits of tolerance can be determined for the Fraser River sockeye.

#### **4. REPORT OF THE SPAWNING ESCAPEMENT ESTIMATION WORKING GROUP**

##### ***Report Summary***

Since 1986, the Department of Fisheries and Oceans (DFO) has had the responsibility of estimating the number of sockeye spawners in the Fraser River. Before 1986, such estimation was the responsibility of the International Pacific Salmon Fisheries Commission (IPSFC). The IPSFC developed a two-tiered system whereby stocks with an estimated return of over 25,000 were subject to mark-recapture techniques, and

stocks with expected returns of fewer than 25,000 were subject to a variety of stock-specific visual estimation techniques. In addition, some stocks were counted by enumeration fences. Due to the importance of consistency, DFO has adopted the same techniques used by the IPSFC.

The Report details estimation techniques and potential sources of bias on specific sockeye stocks from the Early Stuart, Early Summer and Summer runs, as well as an overall accuracy and direction of bias for the 1994 estimations. Data for the fall run are not included in this Report.

The Report concludes that the mark-recapture estimates (accounting for 74 percent of the 1994 estimated summer escapement) were subject to positive bias; that the fence enumerations (18 percent of total estimate) were subject to a minor negative bias; and that the visual surveys (8 percent of total estimate) were subject to negative bias. At the end of the Report there are detailed recommendations for improvements.

### **Board Commentary**

The Board appreciated the detailed appraisal of methodology contained in this Report. We would like, in addition, to emphasize the following points:

1. Spawning ground estimation on a system as widespread as the Fraser is very challenging. Unpredictable difficulties will lead unavoidably to estimation errors.
2. Sockeye spawning activity is constantly evolving, and the estimation system must continually be adapted to these changing patterns.
3. The statistical methodology associated with the visual estimates needs immediate attention.

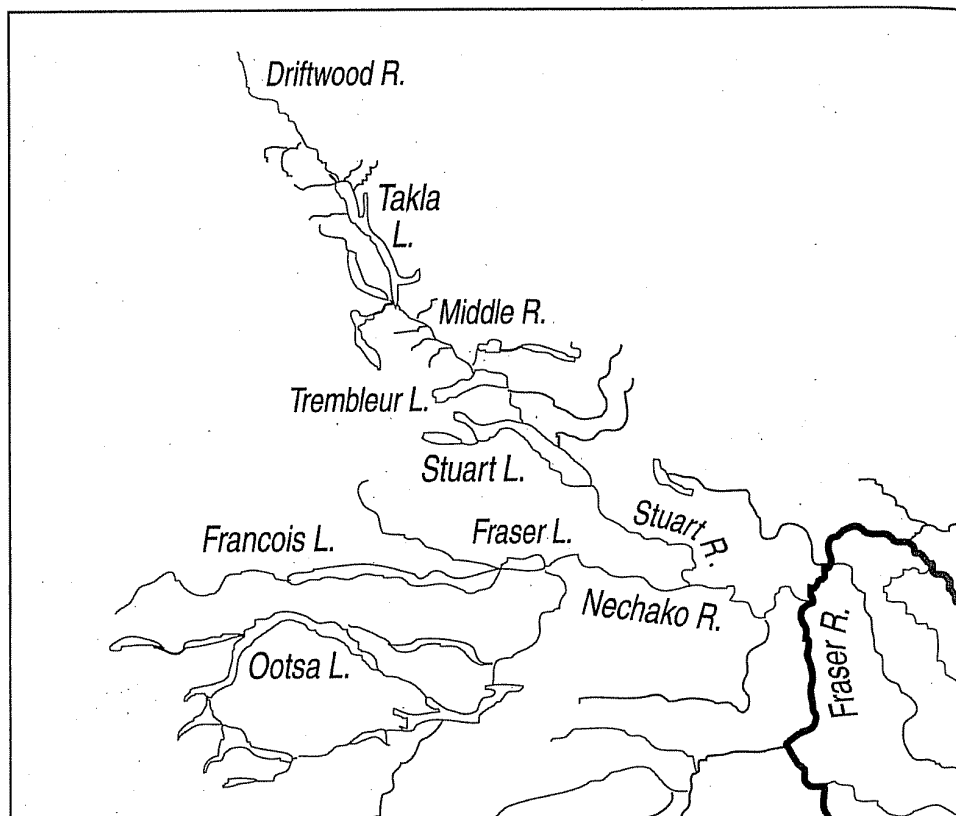
The following is an assessment of the accuracy of the estimates for each of the four major run timing groups.

### **Early Stuart Run**

The Early Stuart run returns to a large number of streams in the northern extremity of the watershed (see Figure H). The Department inventory contains 39 separate spawning areas. The three most heavily used were enumerated by a counting fence. The other 36 were enumerated visually. The 36 visual estimates accounted for 55 percent of the estimated total escapement of the Early Stuart run.

Before commenting on the potential for errors in these estimates, we would like to emphasize the demanding nature of this task. Not only is access to some of the remote spawning areas difficult, but at times it is also dangerous. Surprise changes in

**Figure H**  
**THE STUART RIVER SYSTEM**



*The Stuart River drainage system. Returning sockeye arrive in two waves. The Early Stuart run disperses to about 40 spawning grounds in the northern half of the watershed.*

the size and timing of the sockeye runs can also foil the most thorough plans. In 1993, for example, there was a flood such as is expected to occur only once in 50 years. All five counting fences in the area were wiped out. This was the dominant year for the Driftwood River, and a combined fence-count, mark-recapture and visual survey program had been planned to obtain valuable comparative data in this remote, technically challenging area. The Driftwood fence was out of operation for 10 days. The crew exposed themselves to personal risk to maintain the tagging operation under dangerous conditions. Despite such efforts, the fish were severely stressed, and potential tagging mortality clouded the precision of the estimate.



To compound the crew's problems, the later runs to the Middle and Tachie rivers were stronger than any since 1944. This further unexpected challenge caught the crew with inadequate resources. Despite the best of planning, unforeseeable problems are bound to arise.

The majority of the 1994 estimate was generated from visual surveys. The Board believes that these visual estimates are prone to substantial negative bias. We illustrate our concerns with the 1994 Driftwood River survey.

The remote Driftwood River was surveyed once in 1994, by helicopter on August 12 when it was thought that the spawning run would be at its peak. Approximately 910 live spawners and 254 carcasses were observed. Obviously, not all fish in the river would be spotted on a single overflight. To adjust for this fact, the Department uses data collected from three tributaries of the nearby Middle River. On these three streams there are both fence counts and intensive visual surveys conducted repeatedly from the ground. In 1994, the average ratio of numbers counted at the fences to estimates based on visual surveys was about 1:1.4. This ratio was applied to the aerial count for the Driftwood River to produce the estimate of 1,630 spawners. The actual number of spawners was almost certainly greater. The count from a single overflight would typically be much lower than the three other estimates based on repeated ground surveys. Hence, the ratio of 1:1.4 should almost certainly be higher for this spawning area.

Although it is impossible to quantify the bias in the visual estimates for this or any other area, our technical analysis suggests that it could easily exceed 20 percent on average. This has led us to conclude that the negative bias for the entire run could easily exceed 10 percent.

### **Early Summer Run**

These sockeye disperse to spawning locations scattered widely throughout the watershed from the Pitt River in the Lower Mainland to the Bowron River in the northeast watershed. In a typical year, visual estimates account for a large portion of the total estimate. One would therefore expect some negative bias. In 1994 a surprise change in spawning behaviour on the Eagle River created an inordinate potential for such bias. The Department normally relies on a fence to estimate returns to this river. However, in 1994, the sockeye unexpectedly spawned en masse in a portion of the river below the fence. When it became apparent that most of the stock was spawning below the fence, a two-day visual survey was organized, yielding an estimate of 45,500 spawners. Visual conditions were poor, and the actual number was likely much larger. Previous studies suggest that under such conditions visual estimates can be out by a factor of three or more. We therefore conclude that the actual number of spawners in the Eagle River could have been as high as 136,500, and that the estimate was too small by at least 90,000 fish.

## **Summer Run**

The 1994 Summer runs were dominated by strong returns to the Chilko and Horsefly river systems. Both were estimated by mark-recapture methods. The Working Group Report presents a thorough analysis of potential problems in the Chilko system. We concur with these concerns. We also concur with the conclusion that the Summer run was probably somewhat overestimated.

## **Late Run**

The two major contributors to the 1994 Late run were the Adams-Little River and Lower Shuswap components (see Figure I). The total for each component was estimated by a separate mark-recapture program. The number of spawners in the Adams River was estimated through the following two steps.

Just over 10,000 returning sockeye were captured and tagged as they swam past a site a few hundred metres up the Adams River from Shuswap Lake (see Figure I). Of 200,000 carcasses subsequently found in the area, just over 2,000 were tagged. Thus, about 2 in 10 of the marked fish were seen again after they died. The mark-recapture estimate assumes that the same fraction of all the carcasses from sockeye returning to the area were found. For this to have occurred, there must have been approximately one million sockeye returning.

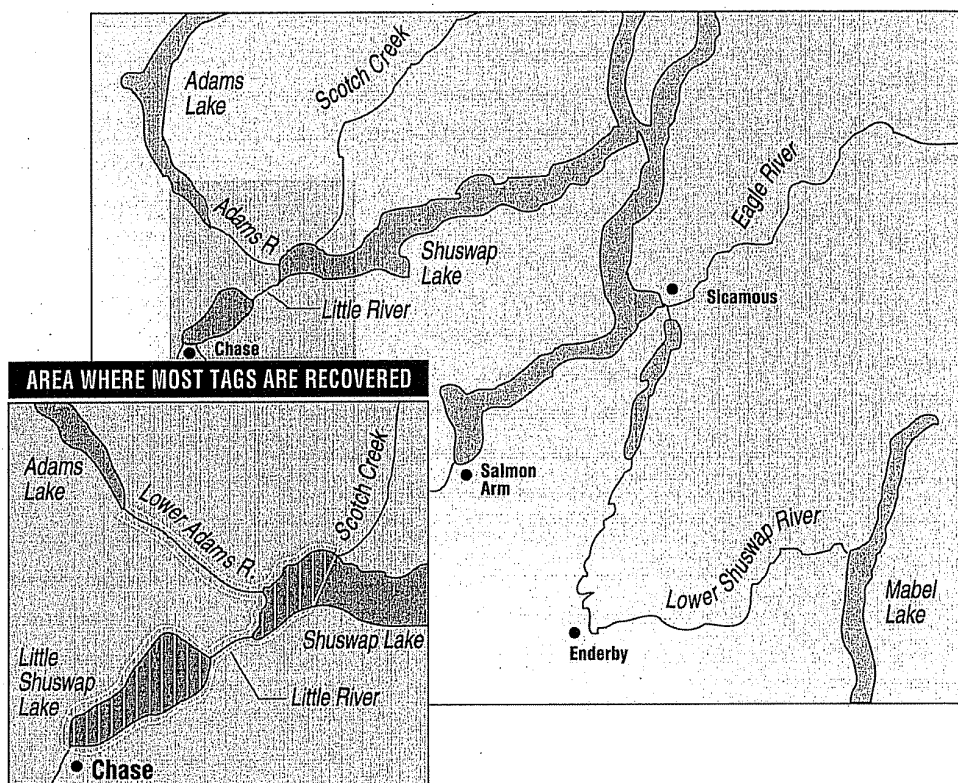
However, the marked carcasses were not all found in the Adams River (see Figure I). Over one third of the tag recoveries were in other spawning areas. Hence, the above estimate covers this more extended area.

Furthermore, the proportion of marked carcasses decreased as the workers moved up the Adams River. Such technical problems, though not unusual in mark-recapture work, are a concern to the Board and DFO staff, as they indicate a potential for positive bias.

The Adams River component was then estimated by subtracting visual estimates for the other spawning grounds in the area. The visual estimate for the Little River was about 200,000 and was based primarily on the results of two helicopter overflights. As with other visual estimates, this one is probably too low. We anticipate that the estimate of 695,000 spawners for the Adams River is therefore positively biased, and that the actual number of spawners was less.

The Late run stocks were outside the Terms of Reference of the internal review team. The Adams River system should be put at the top of the list of areas for revision of spawning escapement methodology.

**Figure I**  
**THE ADAMS/LOWER SHUSWAP AREA**



*The Adams/Lower Shuswap area. Returning sockeye are tagged at a site near the mouth of the lower Adams River. Substantial numbers of tagged fish are found as far away as Scotch Creek and Little Shuswap Lake.*

### **Conclusion**

The first nine of the following suggestions relate to the nine recommendations in the DFO Report of the Spawning Escapement Estimation Working Group.

1. The Stellako River and Scotch Creek, on which there are both fenced areas and mark-recapture programs, provide an excellent opportunity to probe the potential for bias in the latter. However, a more probing study should be undertaken to examine, e.g., possible differential mortality of marked compared to unmarked fish.
2. Simulation studies of the mark-recapture procedures would be useful. Analytical investigations might also provide more general insight and should not be overlooked.

3. Given the potential problems on the Chilko River system cited in the internal Report and the size of this stock complex, we agree that this system should be singled out for special investigation, but suggest that even higher priority be given to the Adams River area.
4. The resampling program for missed tags should definitely be more structured. A different formula also should be developed and the uncertainty over tag loss be incorporated into a better variance estimate. In addition, the method for constructing confidence limits should be revised in light of recent developments in mark-recapture and general statistical theory.
5. We agree that secondary tagging needs to be considered more thoroughly. However, it might not be advisable to apply secondary tags to all marked fish. Secondary tagging would increase the stress on the marked fish, and more reliable results might be attainable from a co-ordinated plan involving partial secondary tagging. The issue needs a thorough investigation.
6. We agree that a fence-count or mark-recapture scheme would seem to be more appropriate for the Eagle River. Furthermore, a policy statement on methods used to watch for shifts in spawning activity to unused areas would be valuable.
7. We agree that enumeration fences have the potential to provide more accurate escapement estimates. Subject to availability of funding and feasibility, their use should be extended.
8. The expansion factors for visual survey results need a thorough re-examination. In addition to the issues raised in the Report, the influence of different survey frequencies, methods (foot *versus* boat *versus* helicopter), stream conditions, observers and auxiliary data on run timing need to be examined. We also suggest that the formula, "peak live counts plus cumulative dead," be revisited, and that a policy for updating expansion factors be created and implemented.
9. We agree that the expansion factor for visual surveys in the Early Stuart run needs to be recalibrated. However, this should become part of the overall plan described above.

Furthermore, we believe that the following should occur:

10. As part of an overall management strategy, a thorough plan for spawning escapement estimation is needed. Fundamental goals for accuracy and precision should be formulated at the stock and run timing group levels. Thorough quality control

practices need to be formulated and enacted. The plan needs to be updated annually in light of new methodology, insight gained from unforeseen problems in the previous year, and changes in fish behaviour and their environment. It needs to contain a feasibility strategy for searching for newly colonized spawning beds. Procedures need to be formally documented, publicly accessible and subject to regular external review by qualified experts. (The Department's procedural reports for coho and chinook methodology provide an excellent example.) A large bureaucracy like the Department, subject to frequent changes in key personnel and intense public scrutiny, needs such a system to regain and maintain its credibility. Furthermore, reasonable time limits for achieving these goals should be set out, and a commitment should be made to their long-term stability. Without such a plan, financial constraints may lead to a dangerously inadequate, ad hoc set of estimation procedures that would put genetically valuable stocks, and possibly major stocks, at risk.

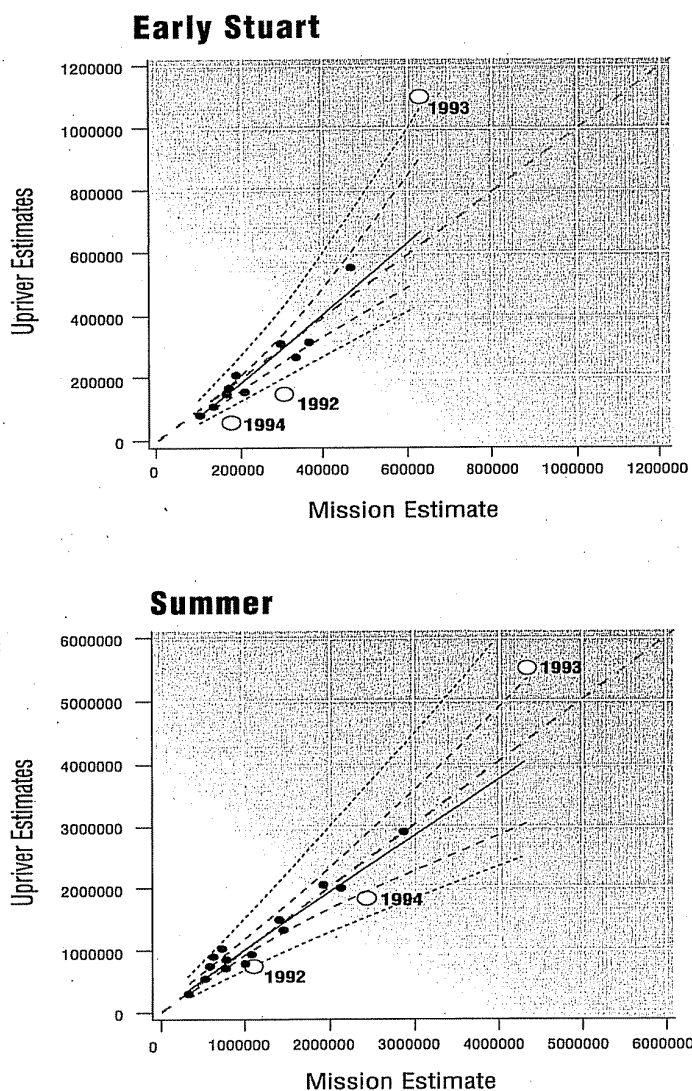
## 5. COMPARISON OF MISSION AND UP-RIVER ESTIMATES

The Board analyzed the data on the historical relationships between the Mission estimates and the up-river estimates provided by DFO's *Internal Report of the Mission Hydroacoustic Facility Working Group*. Of particular interest are the graphs which plot up-river estimates compared to Mission estimates for the four major run timing groups.

In our analysis, we added a 45° line to the graphs that corresponds to perfect agreement between Mission and up-river estimates (see Figure J). Any point not falling on this line contains a discrepancy and presents an opportunity for improvement. A significant departure of a fitted line (or curve) from this 45° line represents a systematic discrepancy that has occurred repeatedly and therefore presents an even greater opportunity for improvement.

We also considered possible improvements to the methods used by the Working Group to compute the fitted lines and curves. Although it is questionable as to the conditions under which the regressions on log-transformed data would be appropriate, we have not found an obviously superior alternative to this method. One potentially serious problem is that the regression calculations assume that the variable on the horizontal axis, Mission estimates in this instance, can be measured without substantial error. This is clearly not the case. The effect of such errors will be to make a regression line less steeply sloped than it ought to be and to make the curves coming from regressions on logarithmically transformed data bend downward more than they would

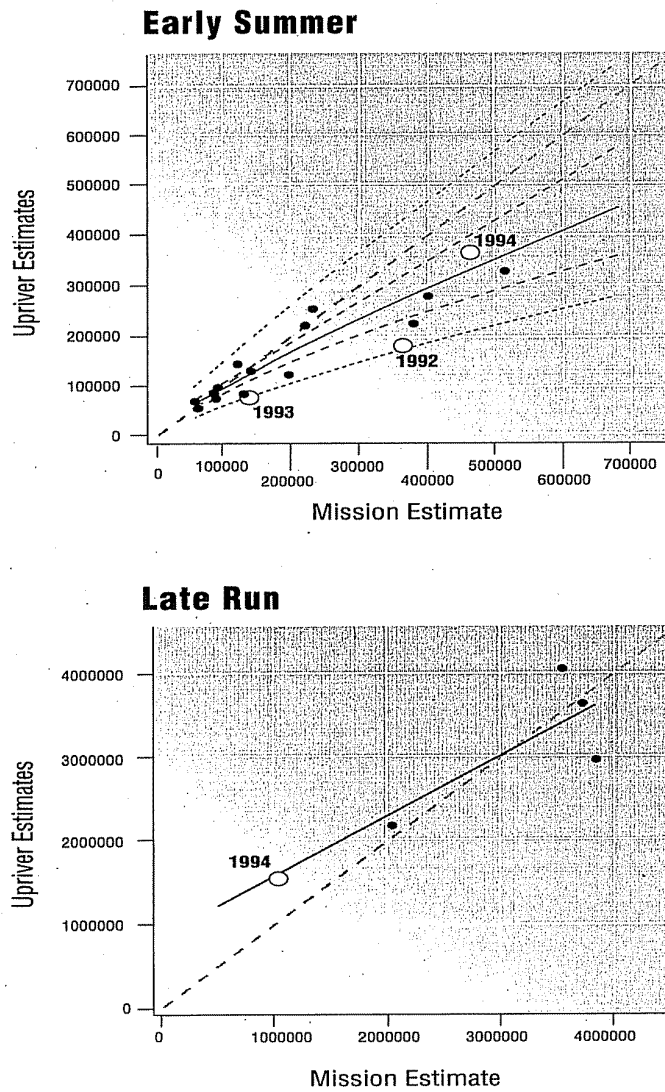
**Figure J**  
**REGRESSIONS OF MISSION VS UPSTREAM ESTIMATES**



1994 Mission Estimates as of January 31, 1995  
Upriver Estimates extracted from Review Team Working Group Reports

*Regressions of annual Mission hydroacoustic estimates of escapement versus the sum of Aboriginal fishery catches and the net escapement upstream of Mission, 1977-91. A linear regression was fitted to long-transformed data and the results back-transformed to an arithmetic scale for plotting. Dashed lines are the 95 percent confidence intervals*

**Figure J (cont'd)**  
**REGRESSIONS OF MISSION VS UPSTREAM ESTIMATES**



for the regression and the dotted lines are the 95 percent prediction intervals. The 1992, 1993 and 1994 data are plotted for comparison. The long-dashed line is the 45° line corresponding to perfect agreement between Mission and up-river estimates. Primary Source: Report of the Mission Hydroacoustic Facility Working Group.



otherwise. The size of this effect depends on the relative magnitude of the errors in the two variables being plotted. Unfortunately, in the absence of reliable, direct information on the relative sizes of these errors, we have been unable to propose an improved alternative.

### **Early Stuart Run Group**

The data used in the Working Group report shows a slight tendency for negative discrepancies in the smaller runs as the fitted curve and three of the points are below the 45° line. The tendency is even more noticeable when logarithmic scales are used.

This tendency could, however, be an artifact of chance errors in the estimates. The probability of obtaining evidence at least as convincing of a regression curve that differs from the 45° line, when the latter is indeed the correct model, can be estimated at 5.4 percent. Most statisticians would regard this evidence as marginally significant.

However, since the 1994 run was small, it is possible that some of the discrepancy for the Early Stuart run group could be attributed to an ongoing, systematic error for small Early Stuart runs. Nonetheless, the 1994 point falls far outside the prediction limits. Something extraordinary clearly happened in 1994. En-route mortality and unreported catch in the essentially unenforced in-river fishery seem to be the most likely causes.

### **Early Summer Run Group**

For the Early Summer run group there is very strong evidence of a systematic pattern to the discrepancies. Only one of the nine largest runs shows a noticeably positive discrepancy above the 45° line. The larger runs show a pronounced negative discrepancy. For this group, the probability of obtaining evidence at least as convincing of a regression curve that differs from the 45° line, when the latter is indeed the correct model, can be estimated at 0.1 percent. This is much smaller than the marginal 5.4 percent probability reported above. There is very strong evidence of a systematic discrepancy.

Furthermore, there is statistically significant evidence that the problem is relatively more acute in years with larger runs. The points further to the right fall proportionately further below the 45° line. The fitted curve bends downward to accommodate this feature. The probability of obtaining evidence favouring a curve at least as strong as what has been observed, when in fact the actual underlying relationship does not curve, is only 1.5 percent.

This run group is the one that contains the largest number of minor stocks. The Pacific Salmon Commission staff are concerned that their stock discrimination algorithm may lead to overestimates of such small stocks. This could explain the negative discrepancies, but might not explain why the pattern is particularly pronounced for years with greater abundance. We suspect that it is also in part due to the fact that



these smaller runs are estimated from visual surveys. Furthermore, in any given spawning area, proportionately more fish may well be missed in years of greater abundance. Bias in visual surveys therefore has the potential to explain the discrepancy pattern.

Data provided in this internal Report would indicate that there is absolutely no evidence that anything unusual happened in 1994 for this run group. The point representing 1994 falls almost exactly on the line. Hence, it appears that the discrepancy in the Early Summer run group is attributable to ongoing systematic biases, and that there is no evidence in these data of any extraordinary errors in 1994.

### **Summer Run Group**

For this group, it appears that there are no systematic departures from the 45° line. Furthermore, the 1994 point is on the low side, but the discrepancy is not extraordinary. The discrepancy is within the range one would expect to see 19 times out of 20. Nonetheless, this not-so-unusual discrepancy represents over half a million fish. Accordingly, unless the estimation techniques are improved, such a discrepancy should be expected to occur from time to time for large run sizes.

### **Late Run Group**

An additional 444,000 fish were estimated up-river than were estimated to have passed Mission. This discrepancy is large, about 40 percent of the Mission estimate. However, there are comparative data from only four other years and none with Mission estimates of less than two million fish. It is impossible to tell whether this large a relative error is within the range that one would normally expect in a year such as 1994 with a Mission estimate of just over one million fish.

Nonetheless, the error is large, and can only be attributable to a combination of a negative bias at Mission and a positive bias in catch and spawning estimation. Potential sources of such biases have been identified in Technical Appendices 1, 2 and 4, and we urge that they be investigated.

### **Conclusion**

The 1994 Summer and Late run estimates provide compelling evidence of the need for an ongoing, focussed effort with two objectives:

1. to integrate uncertainty in estimates into the management system, and
2. to develop continuing improvements to the estimation system.

# *Appendices*

## **1. TERMS OF REFERENCE**

The Public Review Board appointed to examine Fraser River sockeye management will have three main objectives: first, to identify the reason(s) for the discrepancies in the expected and actual number of sockeye salmon arriving on the spawning grounds; second, to evaluate the accuracy of the Pacific Salmon Commission's (PSC) methodology for estimating run sizes and sockeye escapement in the Fraser River; and, third, to make recommendations on how any deficiencies can be corrected, beginning in 1995.

The review will include consideration of the following areas:

1. The accuracy of estimates of the number of sockeye salmon moving past the PSC's hydroacoustic facility at Mission in 1994. This aspect of the review will examine the accuracy separately for each of the four major run components: Early Stuart, Early Summer, Summer and Late Summer. It will include an evaluation of the actual acoustic procedures and the analytical methods used to prepare estimates from acoustic data.
2. The accuracy of estimates of the catch of sockeye salmon in the Fraser River in 1994. This aspect of the evaluation will include an examination of the reliability of the in-river catch monitoring program, techniques used to estimate catches, and procedures for estimating the confidence range around the catch estimates.
3. The level of mortality experienced by sockeye salmon in the Fraser River and on the spawning grounds in 1994. Temperatures throughout the Fraser River were at all time high throughout the period from mid July to mid August 1994. The evaluation will examine the effect of these temperatures, in conjunction with average flow conditions experienced in 1994 and other relevant factors, on the level of mortality experienced by sockeye salmon while en route to the spawning grounds. This evaluation will also identify causes of elevated water temperatures in the Fraser River, including forestry practices.

4. The accuracy of estimates of the number of sockeye salmon on the spawning grounds in 1994. This aspect of the evaluation will include a review of the various techniques used to enumerate sockeye salmon on the spawning grounds, the timing of arrival of the sockeye salmon on the spawning grounds, and the rates of tagging and tag recovery for those stocks enumerated through mark-recapture programs. As required, information from other years will be used in this assessment.
5. In consultation with the PSC, examine the methods used by the Commission to predict returning run strength and escapement, both pre-season and in-season. This aspect will include an assessment of the accuracy and dependability of the estimation methods, including the Mission hydroacoustic facility, PSC-contracted test fisheries, and estimates of catch and removal rates in Johnstone Strait, Juan de Fuca Strait and North Puget Sound fisheries.
6. The level and efficacy of DFO stock management, surveillance, monitoring and enforcement activities in the Fraser River and elsewhere where relevant. This aspect will include an evaluation of these issues; strategies implemented; performance indicators; resources allocated and expended in the fisheries in 1994, including a comparison with previous years; data collection methods in the commercial, sport and aboriginal fisheries; and the estimated magnitude of undetected illegal catches.

The Board will be organized to conduct an independent investigation of these issues involving active participation of all interested parties and stakeholder groups, major organizations and agencies. Meetings, consultations and discussions will be held with a broad cross-section of stakeholders and the public, utilizing an open process that will allow concerned groups and individuals full access to Board members. Written as well as oral submissions to the Board will be encouraged.

Board members will have full access to all relevant Department of Fisheries and Oceans files and personnel, and will have the capacity to interview any departmental officials they deem appropriate. As well as conducting its own research, the Board will direct an internal technical review process being carried out by the Department of Fisheries and Oceans (DFO) and will be kept fully apprised of the internal process and its findings. The Board will also consult with the Pacific Salmon Commission (PSC) and consider their findings.

The Board will receive the technical findings of DFO on or before December 31, 1994, for its consideration. The Fraser River Sockeye Public Review Board will submit its own report to the Minister of Fisheries and Oceans by February 28, 1995, summarizing its findings from the independent review process and making recommendations on actions required to address the situation.

## 2. MINISTER'S PRESS RELEASE DATED SEPT. 26, 1994



# NEWS RELEASE COMMUNIQUE

NR-PR-94-59E

September 26, 1994

### TOBIN ANNOUNCES INDEPENDENT BOARD TO REVIEW FRASER SOCKEYE

**VANCOUVER** --- Brian Tobin, Minister of Fisheries and Oceans, today announced that an Independent Review Board will oversee an examination of discrepancies between predicted and actual returns of sockeye salmon to the Fraser River in 1994.

The Independent Review Board, composed of scientific and legal experts, will be chaired by Dr. Paul LeBlond, an oceanographer from the University of British Columbia. Other members include Joe Scrimger, Dr. Rick Routledge and David Brander-Smith (biographies attached). The Board will have access to Department of Fisheries and Oceans' (DFO) material, research and personnel, as necessary. It will review the progress of a management team set up to investigate the salmon shortfall and provide additional direction to that team for its deliberations. The Board will provide a written evaluation of the team's report as well as its own recommendations.

The Board will begin its work in early October. A final report will be submitted to Minister Tobin by January 31, 1995, including recommendations on how discrepancies may be avoided in the future. Submission of the final report in January will allow time for any necessary changes to management and assessment practices prior to the 1995 fishing season.

"I have asked the independent specialists, in concert with departmental staff, the Pacific Salmon Commission and fishery stakeholders to examine all the factors that may have contributed to the discrepancy between the number of sockeye counted in-river and the total that finally reached their spawning grounds," Mr. Tobin said. "While sockeye returns to the Fraser this season were substantial and conservation needs were met, the lack of certainty in how those returns are counted is a problem that has to be corrected."

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et Océans



Canada

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Four key areas will be examined:

- the accuracy of estimates of the number of sockeye moving past the Mission hydroacoustic facility in 1994;
- the accuracy of estimates of in-river sockeye catches during 1994;
- the level of mortality experienced by sockeye in the Fraser and on the spawning grounds, especially that caused by higher water temperatures in 1994; and,
- the accuracy of estimates of the number of sockeye salmon on the spawning grounds.

The work and findings of the management review team will be made available to fishery stakeholders and the general public. A meeting with stakeholders will be held to consider the 1994 situation, the review process, and to solicit wide-ranging opinion on causes for the discrepancy. A process and schedule for further contributions by stakeholders to the evaluation and the subsequent implementation of recommendations that arise from the review also will be discussed at the meeting with stakeholders.

"I am very pleased that such an eminent group of individuals has offered their expertise through the Independent Review Board," Mr. Tobin said. "I am confident that, with input from the Board, stakeholders, and the management review team, we will find the answers that we are looking for and that we can avoid similar situations in the future."

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**FOR INFORMATION:**

Dr. Mike Henderson  
Department of Fisheries and Oceans  
VANCOUVER  
(604) 666-6746

### 3. MINISTER'S PRESS RELEASE DATED OCT. 3, 1994



## NEWS RELEASE COMMUNIQUE

NR-EQ-94-105E

October 3, 1994

#### TOBIN VOWS TO FIND OUT WHY PACIFIC SALMON COMMISSION ESTIMATES WERE SO FAR OFF BASE

OTTAWA -- Brian Tobin, Minister of Fisheries and Oceans, today said he intends to find out why the Pacific Salmon Commission's estimates of Fraser River salmon were so far off base this year.

The Minister announced that he is adding members to his Independent Review Board of the Fraser River salmon fishery, and extending the Review Board's terms of reference to include an examination of the Commission's system for estimating stocks.

The new Board members are John Fraser, Canada's Ambassador for the Environment, a former Minister of Fisheries and Oceans and a former speaker of the House of Commons, and Lee Alverson of Seattle, Washington, a U.S. fisheries scientist who was a U.S. negotiator prior to the signing of the 1985 Canada-U.S. Pacific Salmon Treaty.

Mr. Tobin said some variables are to be expected every year between the Pacific Salmon Commission's preliminary estimates and its in-season estimates based on later information. "But the variables this year are too large and we were told about them too late," he said.

The Commission has a special role in the management of the Fraser River sockeye and pink salmon, the Minister noted. "The information it provides is the basis for all our decisions to open and close our fisheries."

He said the current problem does not represent a threat to the well being of the Fraser River stocks in the long term: "What it means is that we have slowed the rate of rebuilding. We have a good solid base of stock to ensure the health and abundance of this resource for Canadian fishermen."

Mr. Tobin answered critics who said the lack of agreement with the U.S. on a joint management plan for 1994 is the cause of this

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year's problem. "If we had an agreement with the U.S. on a management plan for 1994, it would still have been based on the same information that was provided to us by the Pacific Salmon Commission," he noted.

"We intend to make our management system better," he stated. "We are open to finding better ways to manage stocks in the future."

Despite the complexity of fisheries management, his department and the Pacific Salmon Commission have done a credible job in maintaining fish populations and increasing their abundance on the Fraser River. "The three largest runs since the Hells Gate slide in 1913 have occurred in the last five years."

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**For information:**

Bonnie Mewdell  
Press Secretary  
Office of the Minister  
Ottawa  
(613) 992-3474

## **4. GLOSSARY**

### **AFS**

Aboriginal Fisheries Strategy

### **Alevin**

A salmon fry whose yolk has been depleted.

### **Allocation**

The number of fish assigned or allotted to a particular group or individual.

### **Bioenergetic modelling**

Computer modelling to estimate the energetic cost of swimming activity for the fish.

### **Catch**

The act of trapping or ensnaring fish.

### **Catch estimation**

A process used to estimate the fish catch.

### **Catch monitors**

Individuals who enumerate the catch of fish for the purpose of catch reporting.

### **Catch per unit effort**

The average number of fish caught per unit of time fishing.

### **Closing**

A formal or official end to a period of legal fishing.

### **Co-management**

The sharing of management responsibilities among two or more agencies or parties.

### **DFO**

Department of Fisheries and Oceans (Government of Canada)

### **Diversion**

The act of the fish moving away from a course or purpose.



**Echo sounder**

Electronic equipment which uses sound waves to detect fish in water.

**Enumeration**

Ascertaining or counting the number of fish.

**Enumeration fence**

A structure placed across a river through which migrating fish must pass. Fish are counted as they pass the fence.

**Estuary**

An area consisting of the mouth or the lower course of a river in which the river's current meets the sea's tide.

**Fishers**

An expression commonly used on the West Coast that refers to both fishermen and women.

**Fry**

Young or freshly hatched fish.

**Habitat**

The area in which an organism would naturally be found; the place that is natural for the life and growth of an organism.

**Hail**

The act of calling in an estimate of fish caught by a vessel or individual.

**IPSEFC**

International Pacific Salmon Fisheries Commission, predecessor the Pacific Salmon Commission.

**Jacks**

Sockeye which return to the spawning grounds after one winter in the ocean, a year earlier than other sockeye hatched in the same year.

**Juvenile salmon**

A young, non-mature salmon.

**Laundering**

A transaction in a legal commercial fishery involving fish caught outside of a legal commercial fishery.

**Mark recapture techniques**

A process used to estimate the number of fish on a spawning ground. Involves marking some fish and then resampling all fish on a spawning ground to determine the marked to unmarked ratio.

**Migration**

The movement of fish from one region or climate to another.

**Negative Bias**

An inaccuracy in an estimation technique or calculation which causes an under-estimation in the number of fish.

**Opening**

A formal or official beginning of a period of legal fishing.

**Overfishing**

Excessive fishing, fishing to depletion.

**Pacific Salmon Treaty**

A treaty established between Canada and the United States of America on March 17, 1985.

**Poaching**

The illicit or illegal catching of fish.

**Positive Bias**

An inaccuracy in an estimation technique or calculation which causes an overestimation in the number of fish.

**PSC**

Pacific Salmon Commission — formed March 17, 1985 as a result of the Pacific Salmon Treaty established between Canada and the United States.

**Radio-tracking**

Using electronic transmitters implanted in fish and receivers to follow fish movement.

**Redds**

Depression in the gravel of a spawning stream where a female lays her eggs.

**Risk aversion management**

A management system geared to conservation of a stock.

**Runs**

One or more stocks of the same species that return to a river over a particular time period.

**Schooling behaviour**

The tendency of fish to form organized groups.

**Smolt**

A young, silvery salmon entering the first stage of its migration to sea.

**Spawning**

The act of producing or fertilizing eggs.

**Stock**

Identifies those fish returning to a general geographical area for spawning.

**Stock enumeration**

Ascertaining the number of fish in each of the stocks.

**Stock rebuilding**

Increasing the size of a fish stock, usually through increasing spawning escapement.

**Tagging**

A process used for placing a mark on a fish so it can be uniquely identified at a later time.

**Test fishing**

Fishing activity designed to provide data from which an estimate of run size can be generated.

**Under-reporting**

Fish caught during an official fishery which, for any reason, are not reported in the official catch reporting system.

## *Appendices*

### **User Groups**

A term encompassing the commercial, Aboriginal and recreational interest groups.

### **Visual surveys**

A process of estimating the number of fish on the spawning grounds based on visual observations from land or air.

### **Watershed**

An area or region drained by a river and its streams and tributaries. Also known as a drainage area.

### **Zooplankton**

Comprised of the aggregation of animal or animal like organisms in plankton.

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Rounsefell, G.A. and G.B. Kelez. "The salmon and salmon fisheries of Swiftsure Bank, Puget Sound, and the Fraser River." *Bulletin of the Bureau of Fisheries* Vol.XLIX, No.27 (1938): 693-823.

## 6. BRIEFS SUBMITTED TO THE BOARD

Adams, Noel (Mr.)  
Alaska Department of Fish & Game  
ARA Consulting Group Inc.  
Archipelago Marine Research Ltd.  
Armstrong, Shirley (Ms.)  
The Assembly of First Nations  
  
B.C. Aboriginal Fisheries Commission  
B.C. Federation of Fly Fishers  
B.C. Fisheries Survival Coalition, Mid-Island Branch  
B.C. Fisheries Survival Coalition, Prince Rupert Branch  
B.C. Fishermen's Redress Committee  
B.C. Ministry of Agriculture, Fisheries & Food  
B.C. Shellfish Growers Association  
B.C. Wildlife Federation  
B.C. Wildlife Federation, Shuswap Region  
Beach, Dorothy (Ms.)  
Birch, Reg & Ina (Mr. & Mrs.)  
Branch, Larry (Mr.)  
Bubl , Lewis (Mr.)  
Buchanan, Bruce (Mr.)  
Bunn, Charlie (Mr.)  
  
The Campbell River Guides Association  
Canada Department of Fisheries & Oceans, Pacific Region  
Canada Department of Fisheries & Oceans, South Coast Division  
Carefoot, Eileen (Ms.)  
Carlisle, Eric (Mr.)  
Carlson, Pierce (Mr.)  
Carrier Sekani Tribal Council  
Coastal Patrol Association  
Co-Operative Fisherman's Guild, Local 80  
  
Dalen, Mary (Mrs.)  
Davis, Tom (Mr.)  
Deep Sea Trawlers Association of B.C.

## *Appendices*

Eidsvik, Odd (Mr.)  
Ellis, David (Mr.)  
English, George (Mr.)  
Federation of B.C. Naturalists  
Fedoruk, Ernie (Mr.)  
Finlayson, Lorne (Mr.)  
Fisheries Council of British Columbia  
Fishing Vessel Owners Association of B.C.  
Fletcher, Jerry (Mr.)  
Fraser Basin Management Program  
Fraser River Coalition  
Fraser Valley Salmon Society  
Freeland, Howard (Dr.)  
Gardham, Murray (Mr.)  
Gjernes, Terry (Mr.)  
Greenpeace Canada  
Griffith, W.E. (Mr.)  
Hill, George (Mr.)  
Hoar, David (Dr.)  
Homalco Indian Band  
Huff, Loretta (Mrs.)  
International Fisheries Gene Bank  
Kandt, Paul (Mr.)  
Kendall, Ruth (Ms.)  
Kershaw, Paul (Mr.)  
Kreutziger, Robert (Mr.)  
Kristian, Ken (Mr.)  
Laich-Kwil-Tach Nation  
Laws, Frances (Ms.)  
LeBurel, Guy (Mr.)  
Leyenaar, Jake (Mr.)  
Marcotte, Barry (Mr.)  
Massey, Doug (Mr.)  
McGregor, Pete (Mr.)  
McGuigan, Peter (Mr.)  
McLean, Euan (Mr.)  
Medenwaldt, Mike (Mr.)



Mennonite Central Committee  
Mitchell, E. (Mr.)  
Mollard, Don (Mr.)  
Mus-Gamagw Tsawataineuk Tribal Council  
Nicola Watershed Stewardship & Fisheries Authority  
Nisga'a Tribal Council  
Nlaka'pamux Nation Tribal Council  
North Thompson Indian Band  
Northern Trollers Association  
  
Oak, Samuel (Mr.)  
Olson, Monte (Mr.)  
  
Pacific Blackcod Association  
Pacific Coast Fishing Vessel Owners' Guild  
Pacific Gillnetters Association  
Pacific Salmon Commission  
Pacific Trollers Association  
Paulik, Wil (Mr.)  
Pavilion Indian Band  
Pepper, Don (Dr.)  
Peterson, Alexander (Mr.)  
Propert, Bruce (Mr.)  
  
Quesnel River Watershed Alliance  
  
Ritchie, Alexander (Mr.)  
Rivette, Steven (Mr.)  
  
Sadoway, David (Mr.)  
Saxvik, Per (Mr.)  
Schleimer, John (Mr.)  
Sechelt Peninsula Rod and Gun Club  
Shepherd, Jean (Mrs.)  
Shuswap Nation Fisheries Commission  
Sierra Club of Western Canada  
Simpson, Rick (Mr.)  
Skeena Fisheries Commission  
Skeena Watershed Committee  
Slack, Terry (Mr.)  
Smith, Kevin (Mr.)  
Spallumcheen Band

## *Appendices*

The Steelhead Society of British Columbia  
Sto:lo Fisheries Authority  
Sto:lo Nation Aboriginal Title & Rights Office  
Stonehouse, George (Mr.)  
  
T. Buck Suzuki Environmental Foundation  
Thomas, Karl (Mr.)  
Thornton Creek Enhancement Society  
Tl'azt'en Nations  
Toboggan Creek Salmon & Steelhead Enhancement Society  
Trigg, Dal (Mr.)  
The Tyee Club of British Columbia  
  
United Fishermen & Allied Workers' Union  
United Fishermen & Allied Workers' Union, Local 31  
United Fishermen & Allied Workers' Union, Locals 31 & 37  
Upper Nicola Band  
  
Walters, Carl (Dr.)  
Woloshuk, Tony (Mr.)  
  
Youds, Mike (Mr.)

## **7. PUBLIC MEETINGS**

### ***Vancouver Trade and Convention Centre***

***November 23, 1994***

#### **Pacific Salmon Commission**

Mr. Ian Todd

#### **Department of Fisheries and Oceans**

Dr. John Davis

Dr. Al MacDonald

Dr. Mike Henderson

Mr. Dick Carson

#### **Dr. Don Pepper**

#### **Pacific Gillnetters Association**

Mr. Ozzie Sexsmith

#### **Nicola Watershed Stewardship and Fishing Authority**

Mr. Arnie Narcisse

#### **B.C. Aboriginal Fisheries Commission**

Ms. Wendy Grant

Mr. Gerald Amos

Chief Ken Malloway

Mr. Richard Watts

Ms. Christine Hunt

Chief Simon Lucas

#### **Nisga'a Tribal Council**

Chief Harry Nyce

### ***Vancouver Trade and Convention Centre***

***November 25, 1994***

#### **Pacific Trollers Association**

Mr. Will Soltau

#### **University of British Columbia Fisheries Centre**

Dr. Carl Walters

#### **Mr. David Ellis**

#### **Fishing Vessel Owners' Association**

Mr. Phil Eby

#### **Sto:lo Fisheries Authority**

Chief Ken Malloway

Mr. Ernie Crey

**Federation of B.C. Naturalists**

Ms. Iris Griffith

**Mr. Doug Massey**

**Mr. Paul Kandt**

**Vancouver Trade and Convention Centre**

*November 29, 1994*

**Dr. David Hoar**

**Fisheries Council of British Columbia**

Mr. Mike Hunter

Mr. Rob Morley

**Greenpeace**

Ms. Catherine Stewart

**Fraser River Coalition**

Ms. Wendy Turner

**United Fishermen and Allied Workers' Union**

Mr. Dennis Brown

Mr. Jack Nichol

**T. Buck Suzuki Foundation**

Ms. Mae Burrows

**United Fishermen and Allied Workers' Union, Locals 31 & 37**

Mr. Arnie Nagy

**Fraser Basin Management Board**

Mr. Ian Waddell

Dr. Tony Dorsey

Mr. David Marshall

**B.C. Fisheries Survival Coalition**

Mr. Rob McKamey

Mr. Bob Rezanoff

Mr. Phil Eidsvik

**Chilliwack, Holiday Inn**

*December 6, 1994*

**Fraser Valley Salmon Society**

Mr. Peter Sellmer

Mr. Fred Helmer

**Steelhead Society of British Columbia**

Dr. Craig Orr

**Mr. Robert Kreutziger and Mr. Blake Covernton**

**Department of Fisheries and Oceans**

Mr. Dick Carson

Mr. Ian Williams

Dr. Tim Mulligan

Dr. Scott Hinch

**Mennonite Central Committee**

Mr. Daryl Klassen

**Sto:lo Fisheries Authority**

Mr. Ernie Crey

Chief Ken Malloway

**Victoria Conference Centre**

*December 12, 1994*

**Fishing Vessel Owner's Association of British Columbia**

Mr. John Lenic

Mr. Bob Rezansoff

**Department of Fisheries and Oceans**

Dr. John Davis

Dr. Howard Freeland

Dr. David Welch

Dr. David Blackburn

**B.C. Wildlife Federation**

Mr. Wayne Harling

Mr. Bill Wimpney

Mr. Bill Otway

**Pacific Coast Black Cod Fishermen's Association**

Mr. Eric Wickham

Mr. Robert Fraumeni

**Sierra Club of Western Canada**

Ms. Sharon Chow

Mr. Byron Nutton

**B.C. Fisheries Survival Coalition, Mid-Island Branch**

Mr. Bob Alford

Mr. Pat Fraser

Mr. Adrian Belveal

**B.C. Shellfish Growers Association**

Ms. Debra Logan

**Ms. Debra Logan**

**Campbell River, Austrian Chalet Village**

**December 13, 1994**

**Gulf Troll Advisory Board**

Ms. Jean Sheppard

**Sto:lo Fisheries Authority**

Mr. Ernie Crey

**Campbell River Guides Association**

Mr. Jeremy Maynard

**Mr. Lorne Finlayson**

**B.C. Fisheries Survival Coalition**

Ms. Lorraine Howich

**North Island Prawn Association**

Mr. Bob Martin

**Campbell River, Austrian Chalet Village**

**December 14, 1994**

**B.C. Fishermen's Redress Committee**

Mr. Jack Larson

**Mr. Peter McGuigan**

**Department of Fisheries and Oceans**

Mr. Ed Lochbaum

Mr. Norm Lemmon

Mr. Paul Ryall

**Prince Rupert, Highliner Inn**

**January 9, 1995**

**Mr. Odd Eidsvik**

**Skeena Fisheries Commission**

Mr. Mark Duiven

**Mr. Mike Scott, MP (Skeena)**

**Department of Fisheries and Oceans**

Mr. Chris Dragseth

Mr. David Einarson

**Ms. Mary Dalen**

**Toboggan Creek Salmon Enhancement Society**

Mr. Mike O'Neill

**B.C. Survival Coalition**

Mr. Paddy Greene

Mr. Phil Eidsvik

**Williams Lake, Convention Centre**

*January 12, 1995*

**Mr. Gord Allen**

**Mr. Bill Houghtaling**

**Cariboo Tribal Council**

Mr. Simon Moses

Mr. Ralph Philips

Mr. Gary Ducommum

**Ts'ilhqot'in National Government**

Mr. Joe Alphonse

Mr. Randy Billyboy

**Quesnel River Watershed Alliance**

Ms. Nora Nicol

Ms. Lisa Bland

Mr. Chris Blake

**Kamloops, The Place Inn**

*January 20, 1995*

**Ms. Loretta Huff**

**Coastal Patrol Association**

Mr. Ken Widsten

Mr. Chris Bunn

**Department of Fisheries and Oceans**

Dr. Mike Henderson

**B.C. Wildlife Federation**

Mr. John Carter

**Shuswap Nation Fisheries**

Mr. Fred Fortier

Mr. Dave Moore

Mr. Micheal Galesloot

Chief Nathan Mathew

**Mus-Gamagw Tsawataineuk Tribal Council**

Chief Pat Alfred

## 8. ROUNDTABLE MEETINGS

### **Roundtable Meeting of Experts**

**Vancouver, Wedgewood Hotel**

**January 22-24, 1995**

Dr. Donald Bevan

*(College of Ocean and Fishery Sciences, University of Washington)*

Dr. Parzival Copes

*(Department of Economics, Simon Fraser University; Institute of Fisheries Analysis)*

Mr. Don Cruickshank

*(former president/owner, Seafood Products Company)*

Mr. Jim Fulton

*(Executive Director, The Suzuki Foundation)*

Dr. Michael Healey

*(Director, Westwater Research Centre, University of B.C.)*

Dr. Peter A. Larkin

*(Marine Mammal Research Unit, Fisheries Centre, University of B.C.)*

Mr. Charles Meacham

*(former Deputy Commissioner, Alaska Department of Fish and Game)*

Dr. Peter H. Pearce, C.M.

*(Department of Forest Resource Management, University of B.C.)*

Mr. John Roos

*(Vice President, Pacific Seafood Processors Association;  
President, North Pacific Marine Science Foundation)*

Dr. Carl Schwartz

*(Department of Mathematics and Statistics, Simon Fraser University)*

Mr. Ian Waddell

*(Chair, The Fraser River Basin Management Program)*

Dr. Carl Walters

*(Department of Zoology, University of B.C.)*



**Meeting with USA Section of the Fraser River Panel\***

**Bellingham WA, Best Western Lakeway Inn**

**February 1, 1995**

Mr. W. Ron Allen

*(Jamestown Klallam Tribe)*

Mr. A. Dennis Austin

*(Washington Department of Fish and Wildlife)*

Mr. Robert Conrad

*(Northwest Indian Fisheries Commission)*

Mr. Jack Giard

*(Washington Reef Net Owners' Association)*

Mr. Michael Grayum

*(Northwest Indian Fisheries Commission)*

Mrs. Lorraine Loomis

*(Swinomish Tribal Community)*

Mr. William Robinson

*(National Marine Fisheries Service)*

Ms. Teresa Scott

*(Washington Department of Fish and Wildlife)*

Mr. Robert Suggs

*(Puget Sound Gillnetters' Association)*

Mr. Tim Tynan

*(Washington Department of Fish and Wildlife)*

Mr. Charles K. Walters

*(National Marine Fisheries Service)*

\* The Board was invited by the United States Department of Commerce (National Oceanic and Atmospheric Administration) to meet with the U.S.A. Section of the Fraser River Panel.

## 9. BOARD MEMBERSHIP

**Chairman:** The Honourable John A. Fraser, P.C., Q.C.

**Board Members:** Dr. Lee Alverson  
Mr. David Brander-Smith, Q.C.  
Dr. Paul LeBlond  
Dr. Richard Routledge  
Dr. Joseph Scrimger

**Executive Director:** Mrs. Sheila-Marie Cook

### **Chairman**

The **Honourable John A. Fraser** is highly regarded in Canadian public life. He is respected for his work as Minister of the Environment, Minister of Fisheries and Oceans, his many achievements as Speaker of the House of Commons, and for his long standing involvement in fisheries, forestry and the environment. As Speaker, Mr. Fraser established the Central and Eastern European Parliamentary Co-operation Programme, the House of Commons Public Information Office, the House of Commons Programme for the Disabled, and the Environmental Greening of the Hill programme involving all MPs and staff in Ottawa. Mr. Fraser also arranged for the writing and publishing of a new book on Parliament entitled *The House of Commons at Work* for students and the public. Mr. Fraser is associated with a number of outdoor/environmental organizations, the Canadian Wildlife Foundation, the World Wildlife Fund, the B.C. Wildlife Federation and the Steelhead Society. Mr. Fraser was appointed Canada's Ambassador for the Environment by Prime Minister Chretien in February 1994. Mr. Fraser resides in Vancouver and works in Vancouver and Ottawa and abroad as required.

### **Board Members**

**Lee Alverson** is a highly regarded fisheries specialist honoured for his contributions over the past four decades to the world's fisheries resources. Dr. Alverson has served in a number of capacities, as commissioner for the U.S. Section of the International North Pacific Fisheries Commission, chief of staff for the U.S. delegation to the U.S./Canada Salmon Interception Negotiations and special advisor to the Minister of Fisheries and Oceans in Canada. In the international arena, Dr. Alverson served as the chairman of the Advisory Committee on Marine Resources Research of the United Nations Food and Agriculture Organization (UN/FAO) and is currently a member of the board of trustees of the International Center for Living Aquatic Resources Management in the Philippines. Dr. Alverson has conducted fisheries management

and development reviews in Kenya, Tanzania, Zanzibar, Oman and Canada and has acted as advisor to the Prime Minister on fisheries in the Cook Islands. He is widely published and the recipient of many awards and distinctions. Dr. Alverson resides in Seattle, Washington and is the owner/president of Natural Resources Consultants, Inc., Seattle and serves as a Professor of Fisheries at the University of Washington, Seattle and has been a distinguished lecturer at Memorial University, St. John's, Newfoundland and a McMillan Lecturer, University of British Columbia, Vancouver.

**David Brander-Smith, Q.C.** is a lawyer specializing in shipping and maritime law, environmental law and the law of the sea. In his capacity as chairman of the Federal Public Review Panel on Tanker Safety and Marine Spills Response Capability, Mr. Brander-Smith chaired public hearings in 31 cities and communities throughout Canada and the Arctic. The outcome of this work is evidenced in the 107 recommendations put forward in the panel's report. He is a qualified arbitrator and mediator and is the director of the B.C. Arbitration and Mediation Institute and director of the Arbitration and Mediation Institute of Canada. He is the past president and an honorary life member of the Canadian Maritime Law Association. Mr. Brander-Smith resides in Vancouver, B.C.

**Paul LeBlond** is currently the director for the Program in Earth and Ocean Sciences at the University of British Columbia, where he has also served as head of the Department of Oceanography and Associate Dean of Science. Dr. LeBlond has extensive experience in ocean sciences and has served as chairman on the Canadian National Committee of WOCE (World Ocean Circulation Experiment) and as a member of the board for the International Council for Ocean Development. He is board member for the Pacific Institute of Deep Sea Technology and the Canadian Centre for Fisheries Innovation. Dr. LeBlond is active in conservation and fisheries management issues and is a member of the Fisheries Resources Conservation Council, an advisory body to the Minister of Fisheries and Oceans. Dr. LeBlond resides in Vancouver, B.C.

**Richard Routledge** is a professor of Mathematics and Statistics at Simon Fraser University in B.C. Dr. Routledge specializes in statistical methodology for producing population estimates. His research ranges from specific human populations to waterfowl and insect populations. For a number of years he has worked on estimation methods used for general fish populations, and is familiar with many of the techniques used to estimate west coast salmon population abundance. As part of his university research, Dr. Routledge is currently working on methods of estimating fish abundance through the use of mark-recapture techniques employed in fisheries research. He is a member of the International Statistical Institute and a director on the board of the Statistical Society of Canada. Dr. Routledge resides in Port Coquitlam, B.C.

**Joseph Scrimger** is an underwater acoustics specialist. Dr. Scrimger is a respected expert in his field and for many years was a scientist with the Canadian Defence Research Board where, among other activities, he was the group leader of the Defence Research Establishment Pacific (DREP) involved in research efforts in sound propagation and studies of acoustic back-scattering and ambient noise in the Pacific Ocean. During his time with the Canadian Defense Research Board, Dr. Scrimger spent time in Italy (NATO) on studies in connection with Reliable Acoustic Path Sonar. He has been a member of the West Coast Sonar Improvements Committee and is currently a member of the Acoustical Society of America and the Canadian Acoustical Society. He is the owner and president of JASCO Research Ltd., in Sidney, B.C., a company specializing in underwater acoustics, signal processing, instrumentation and software and hardware development. Dr. Scrimger resides in Sidney, B.C.

### ***Executive Director***

**Sheila-Marie Cook** has extensive knowledge and experience in the administration of commissions of inquiry. Mrs. Cook has worked at all levels of government and has acquired a strong background in strategic planning and communications for public consultations. As a senior advisor, she has served on more than a dozen commissions of inquiry including the Royal Commission on Aboriginal Peoples. She was, as well, the City of Calgary's Chief of Protocol for the 1988 Olympic Winter Games. Mrs. Cook's permanent residence is in Canmore, Alberta.

## **10. BOARD STAFF**

### **OFFICE OF THE EXECUTIVE DIRECTOR**

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**Executive Director**

Sheila-Marie Cook

**Administrator**

Maureen Cowin

**Administrative Assistant**

Marie Drost

**Information Systems Coordinator**

Noel Harding

**Communications Assistant**

Tara Rasmussen

**Receptionist**

Melissa Stewart

### **LEGAL AND POLICY**

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**Senior Advisor**

George Heinmiller

**Analyst**

Cheryl Webb

### **PUBLIC CONSULTATIONS**

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**Senior Advisor**

Paul Hemsley

**Analyst**

Lisette Gourdine

## **11. CONTRACTORS**

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