INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION

APPOINTED UNDER A CONVENTION
BETWEEN CANADA AND THE UNITED STATES FOR THE
PROTECTION, PRESERVATION AND EXTENSION OF
THE SOCKEYE AND PINK SALMON FISHERIES IN
THE FRASER RIVER SYSTEM

ANNUAL REPORT
1966

COMMISSIONERS

DeWITT GILBERT	SENATOR THOMAS REID
CLARENCE F. PAUTZKE	W. R. HOURSTON
THOR C. TOLLEFSON	RICHARD NELSON

NEW WESTMINSTER
CANADA
1967

INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION

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DIRECTOR OF INVESTIGATIONS
LOYD A. ROYAL

NEW WESTMINSTER
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FIGURE 1 — A typical section of Upper Pitt River sockeye spawning grounds. Note debris and evidence of unstable channels.

REPORT OF THE
INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION
FOR THE YEAR 1966

Utilization of the natural resources inherent in the Fraser River watershed is accelerating rapidly. Since similar developments elsewhere have usually been accompanied by a decline in the native salmon populations, the International Pacific Salmon Fisheries Commission must continually assess its terms of reference "to protect and preserve the Fraser River sockeye and pink salmon fishery". On the basis of historical evidence, the simplest way to protect and preserve these fisheries would be to recommend that the watershed be maintained in its natural state. In this way the freshwater environment would remain undisturbed except by the natural cycles in the weather pattern. However, even at the time the Commission's terms of reference were defined by the Governments of Canada and the United States, some minor sockeye runs had already been destroyed by hydroelectric development in the Fraser watershed. In addition, logging of watersheds and mining were underway and a pink salmon run was being destroyed by water diversion. In fact, the major decline in the Fraser River sockeye and pink salmon runs which brought about the Sockeye Salmon Fisheries Convention proved to be primarily the result of railroad construction and not overfishing, as was believed originally.

The utilization of natural resources, including the harvest of salmon for food and recreation, is a fundamental necessity for the maintenance of civilization and the development of a social order. Logically therefore, the Commission interprets its terms of reference to mean that through research, collection of data, and experience it is to advise the governments involved how best the salmon resource of the Fraser can be protected and preserved during the multi-purpose development of the watershed. Lacking any legal authority beyond this initial action it can hardly interpret its responsibilities otherwise.

Fortunately, the Commission not only has a major accumulation of information dealing with the specific survival requirements of Fraser River sockeye and pink salmon, but it also has available a rapidly increasing fund of knowledge and experience obtained by other agencies. It is now possible to predict accurately some of the adverse effects of multi-purpose watershed development and how these effects can be modified or eliminated. It seems an opportune time for the Commission to report on its current appraisal of how well the Fraser River sockeye and pink salmon are being protected and preserved and what further action is needed to provide for their future maintenance and protection.

Timber harvesting has now developed in almost every section of the Fraser watershed. The inescapable effect of logging is more rapid run-off from streams during periods of precipitation or snow melt, and lower flows during the dry season with corresponding increases in water temperature, particularly during the summer months when many of the salmon populations are en route to, or on, the spawning grounds. Stream beds originally stabilized under normal flow conditions become unstable under higher flows. Erosion of river banks is accelerated, with a sealing of gravel interstices by silt and a shifting of otherwise stable gravel beds as a result of increased flow. Stream channels become wider

and large unstable deposits of gravel occur in the lower valleys where many of the important salmon spawning areas are located. Later during low water periods, usually at the time salmon spawn, temporary channels are established through these gravel deposits only to be changed by the next rise in water.

Salmon eggs are lost in the eroding or shifting gravel beds, and killed by silt sealing off the vital water flow through the gravel itself. Figure 1 dynamically illustrates the inevitable and cumulative effect of logging on most streams affected by the coastal climate.

Adult salmon, being cold-blooded animals, may find the increased summer water temperatures intolerable and become susceptible to disease, tending in some cases to die unspawned. Furthermore, while the relationship of larval development during incubation to ultimate survival is not yet understood, there is increasing evidence that changes in the thermal, chemical and physical structure of a stream may affect the ability of the young salmon to survive to the adult stage, even though unusual mortality may not be immediately evident. Unless ameliorating action is taken, the inevitable effect of extensive logging of stream watersheds is a significant decrease in the rate of reproduction and, in some cases, the total destruction of specific salmon populations.

Fortunately, in the case of Fraser River sockeye, nature has provided limited insurance against the disastrous effect of watershed logging. Most of the major populations spawn below large lakes. These lakes not only stabilize rapid fluctuations in flow and clarify silt-bearing waters, but also eliminate thermal effects of inflowing streams brought about by the removal of forest cover. The Late Stuart, Stellako, Chilko and Adams River sockeye populations and certain other smaller populations are protected in this manner. Even the large pink salmon runs of the Thompson River and Seton Creek are similarly protected, and the major pink salmon population spawning in the main Fraser currently appears to be relatively free from the adverse influences described above. Thus, the maintenance of these limited but highly important salmon spawning areas, as salmon producing sanctuaries, becomes of vital importance to the future of a large part of the Fraser River sockeye and pink salmon resource.

Spawning tributaries of the Fraser River having no modifying lake systems, and subject entirely to the effects of logging, must be considered with respect to their productive capabilities in future years. As has been stated previously, logging may entirely destroy their productive capacity. Certainly, removal of watershed cover will reduce the rate of reproduction at the expense of the fishery resource unless some corrective action is taken.

The Commission staff, in cooperation with the Department of Fisheries of Canada, has been engaged for about fifteen years in studying and developing a means of compensating for unstable or lost spawning areas. In the Fraser watershed, a flow-controlled spawning ground has been constructed on Weaver Creek to prevent this sockeye population from being destroyed. An incubation channel, described in previous Annual Reports, has been operated on the Upper Pitt River since 1963 to prevent the gradual destruction of this valuable sockeye population. Over the last few years the spawning grounds of these two streams

have become so unstable as a result of watershed logging that the rate of natural reproduction is insufficient to maintain the populations if they are subjected to a normal fishery.

The operating problems of spawning and incubation channels, the true cost of operation, and the fry-to-adult survival rates have yet to be fully established but the benefits indicated to date appear substantial. There are sound biological reasons to believe that these artificial aids to salmon production will serve their purpose in most cases on the basis of a high benefit-to-cost ratio. However, development of these facilities to compensate for spawning grounds lost or injured due to logging is restricted in some locations by the terrain of the stream valley and the character of the stream itself. It may not be possible in every case to compensate completely for the effects of logging, but research and experimentation will be continued in the sincere belief that this operation will lead to the maintenance of the reproductive potential of the sockeye and pink salmon populations of the Fraser River. Artificially increasing the egg-to-fry survival rate over that obtained by natural reproduction, low as it is under the most favorable circumstances, is a tantalizing challenge. Potential benefits can be very large if the increase in the rate of egg-to-fry survival can be obtained without significantly affecting the fry-to-adult survival rate.

In the advancement of our social structure in North America, public demand has resulted in a measure of fiscal responsibility on the part of the manufacturing and mining industries to alleviate any pollution problem created by their waste products. Likewise, the hydroelectric agencies have been required to provide a limited amount of protection to fish life affected by their operations. Actually, the responsibility in the case of dam builders dates back to the Magna Carta. On the other hand, except for improvements in logging practices, the logging industry has not been held responsible for any of the possible damages to other public resources. These damages have been accepted as a public responsibility rather than a charge against the industry itself, either in whole or in part. As long as this philosophy exists, offsetting the damage caused to the renewable and valuable fisheries resource becomes a government responsibility assuming it considers such action to be in the public interest.

The rate of utilization or manufacture of timber products in the Fraser River basin develops in relative proportion to the degree of timber harvesting. Three kraft pulp mills are now in operation, two in Prince George and one in Kamloops. An additional mill is under construction in Prince George and another in Quesnel. These mills result in a rapidly increasing local population because of heavy labor demands, both for timber harvesting and the operation of the mills themselves. Chemical plants to supply the pulp mills are an inevitable result. A major pollution problem arises, not only from these manufacturing plants and their use of large volumes of water, but also from the growing cities and other industries associated with them. Additional new developments not directly associated with the timber industry include a steel mill, breweries, meat and food processing plants, gravel supply pits, cement plants and oil and phenol refineries, all of which have a potentially toxic effluent.

It is a pleasure to report that the Department of Fisheries of Canada requires all industrial effluent to be non-toxic to fish life *before* it is discharged

into the Fraser River or its tributaries. Industry has been generally cooperative in every case and the most modern treatment processes have been installed. Pulp mills recover the major share of chemicals used in the pulping process, reuse water to the maximum currently considered practical, and subject the residual effluent to biological treatment before discharging it into the Fraser River or its tributaries. Bioassays show that if these treatment processes are operating effectively, as they can after an initial shakedown period, young salmon will live in undiluted effluent for four days without mortality. A continuation of this policy combined with the full cooperation of each of the manufacturing plants means that an industrial pollution problem, relative either to fish life or to water reuse by industry itself, should never occur. The public demand for sewage treatment development by cities and municipalities is gaining momentum indicating that control of this type of pollution will gradually be realized.

Mineral deposits of several kinds and of major size are now being exploited throughout the river basin. Although large quantities of water are utilized in the refining of ore, field tests to date reveal no evidence of toxic metallic substances in either the Fraser River or those tributaries utilized for spawning by sockeye and pink salmon. In addition, no permits for placer mining operations have been granted where such operations would obviously be injurious to pink and sockeye salmon production.

Extensive hydroelectric power development of the main Fraser River has always posed a major threat to the future of the salmon resource. Fishery scientists have found the effects of this type of development to be so complex that species such as sockeye and pink salmon, which are highly sensitive to changes in their freshwater environment, would literally face extermination, regardless of the fish protective facilities provided. Fortunately, the Government of British Columbia, by developing the alternative hydro resources of the Upper Columbia and Peace Rivers, and by the future development of the power resource of other streams draining into the Arctic Ocean, will protect the major up-river part of the Fraser River salmon resource from almost certain annihilation.

All large river systems are subject to floods and the Fraser River is no exception. The last major flood occurred on the Fraser in 1948 and extensive property damage resulted. Because of increased utilization of the flood plain by industry and suburban development, the inevitable recurrence of such a flood will cause considerably greater damage. Two inter-related flood plans prepared by a federal-provincial planning group have the general approval of official fisheries agencies. One plan calls for raising the height of dikes in the lower mainland area; the other provides for the construction of multi-purpose storage and hydroelectric projects on the Upper Fraser River and several major tributaries, all to be located above any existing spawning areas for sockeye and pink salmon.

The raising of dikes to meet maximum flood requirements raises no foreseeable fisheries problems, and the proposed project for storing flood waters conceivably could improve conditions for the migration of sockeye and the reproduction of pink salmon. However, some questions remain as to what

effects the proposed water storage and power projects might have on the salmon resource because of existing unknowns in the relationship of environment to ultimate salmon survival. Then too, trying to meet the known requirements of the fish, the requirements for flood control, together with development of electric power might prove to be too formidable a task in the same operation. Nevertheless flood protection is an absolute necessity and it is hoped that at least some effective measures will be provided before, and not after, the inevitable occurrence of the next major flood. The development of proper flood protection measures is not normally possible in an environment created by lost lives, lost livestock, flooded homes and damaged industries.

In summary it can be stated without qualification that there is no historical precedent for the quality of planning inherent in the development and protection of the natural resources of the Fraser River basin. Much of the current protection of salmon resources in the Fraser watershed is the result of policies established by the Governments of Canada and British Columbia. The inescapable effects of dams and the growth of pollution problems demonstrated elsewhere have been considered fully. Scientific research by the Commission and associated fisheries agencies has provided valuable data vitally necessary for adequate fisheries protection.

A conservative but continuing budget covering research, management and the gradual development of artificial aids to protect the sockeye and pink salmon resource is required by the Commission if it is to fulfill its terms of reference and do its part in avoiding pitfalls in planning that inevitably result from lack of adequate knowledge. Crash programs stimulated by the emotionalism of failure are not economically sound.

COMMISSION MEETINGS

The International Pacific Salmon Fisheries Commission held fifteen formal meetings during 1966 with the approved minutes of these meetings being submitted to the Governments of Canada and the United States. The first meeting of the year was held on January 14, with Senator Thomas Reid serving as Chairman and Mr. DeWitt Gilbert as Vice-Chairman and Secretary. A report on the proposed second Seton Creek spawning channel was considered in conjunction with other matters pertaining to the administration of the Commission. The Commission also met with its Advisory Committee composed of the following members:

Canada	*United States*
Robert Wright Sport Fishermen	Howard Gray Sport Fishermen
Richard Nelson Salmon Processors	John Plancich Salmon Processors
Charles Clarke Purse Seine Fishermen	N. Mladinich Purse Seine Fishermen
R. H. Stanton Troll Fishermen	J. Erisman (alternate for F. Bullock) Troll Fishermen
H. Stavenes Purse Seine Crew Members	John Brown Reef Net Fishermen
E. Arkko (alternate for Peter Jenewein) Gill Net Fishermen	Vernon Blake Gill Net Fishermen

The tentative recommendations for regulatory control of the 1966 sockeye salmon fishery in Convention waters, as submitted to the Advisory Committee by the Commission on December 17, 1965, were reviewed and certain revisions made on the basis of the representations of the Advisory Committee.

The Commission met in executive session on June 7 and 8, 1966, to examine current operating problems. Mr. Thor C. Tollefson, Director of Fisheries for the State of Washington, was welcomed as a new Commissioner replacing Mr. George C. Starlund. Staff reports were given on the following subjects: 1. The status of the report on the Indian fishery, 2. Progress of pollution research with respect to the required treatment of kraft pulp mill effluent, 3. Egg-to-fry survival rates of various sockeye and pink salmon populations of the Fraser River watershed, 4. The effects of log driving on the spawning grounds of Stellako River. Additional reports were given on fishway construction, proposed artificial spawning channels and other Commission investigations. The Commission considered and approved the operational and construction budgets for the 1967-68 fiscal year. The Commission and staff members also toured the Kamloops Pulp and Paper Company plant at Kamloops, British Columbia.

On June 28, 1966, the Commission met in executive session and discussed the harvesting problems related to hatchery-raised chinook salmon stocks in certain Convention waters in the State of Washington. Regulatory measures designed to minimize the effect of Commission regulations with respect to sockeye and pink salmon on the harvesting of chinook salmon were approved. The Commission authorized the Director to proceed with a report covering the cause and possible means of controlling the mortality of unspawned sockeye in the Horsefly River.

Eleven meetings of the Commission were required between July 26 and September 26, 1966, to achieve, by adjustment of fishing regulations, the desired escapement and equitable division of the allowable catch of sockeye salmon. The meeting on August 27, 1966, was held with the Advisory Committee.

The fifteenth and final meeting of the year was held on December 14, 15 and 16, 1966, with the first two days devoted to general business. The Commission welcomed Mr. Richard Nelson as a member of the Commission, replacing Mr. A. J. Whitmore who retired October 31 after 27 years of valuable and effective service. Mr. Kenneth Fraser was appointed to replace Mr. Nelson on the Advisory Committee as representative of the Canadian salmon processors and Mr. Charles Mechals was appointed to replace the late Mr. F. Bullock as representative of the United States troll fishermen. On December 16, 1966, the annual open meeting was held with the Advisory Committee and approximately 600 members of the fishing industry and interested government agencies. The characteristics of the 1966 fishing season, a summary of possible factors influencing the size of the 1967 sockeye and pink salmon runs in Convention waters, and the tentative proposals for regulation of the fishery for these species were presented for later consideration by members of the Advisory Committee with their respective segments of the fishing industry.

1966 REGULATIONS

Recommendations for regulations governing the 1966 sockeye and pink salmon fishery in Convention waters were adopted at a meeting of the Commission held on January 14, 1966, and submitted to the two national governments for approval and to the State of Washington for implementation on March 3, 1966. The recommendations for Canadian Convention waters were implemented by the Government of Canada in an Order-in-Council dated May 5, 1966, and for United States Convention waters by an Order of the Director of the Washington State Department of Fisheries on April 30, 1966.

The recommendations of the Commission were as follows:

Canadian Convention Waters

"The International Pacific Salmon Fisheries Commission appointed pursuant to the Convention between Canada and the United States of America for the protection, preservation and extension of the Sockeye Salmon Fisheries of the Fraser River System, signed at Washington on the 26th day of May, 1930, as amended by the Pink Salmon Protocol signed at Ottawa on the 28th day of December, 1956, hereby recommends that regulations to the following effect, in the interests of such fisheries, be adopted by Order-in-Council as amendments to the Special Fishery Regulations for British Columbia for the season of 1966 under authority of the Fisheries Act, namely:

1. (1) No person shall fish for sockeye or pink salmon in the waters of the southerly portion of District No. 3 embraced in Area 20 with purse seines:

(a) From the 26th day of June, 1966, to the 30th day of July, 1966, both dates inclusive; and

(b) From the 31st day of July, 1966, to the 3rd day of September, 1966, both dates inclusive, except from six o'clock in the forenoon to six o'clock in the afternoon of Monday and Tuesday of each week; and

(c) From the 4th day of September, 1966, to the 10th day of September, 1966, both dates inclusive, except from seven o'clock in the forenoon to seven o'clock in the afternoon of Monday and Tuesday.

(2) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with gill nets:

(a) From the 26th day of June, 1966, to the 30th day of July, 1966, both dates inclusive; and

(b) From the 31st day of July, 1966, to the 3rd day of September, 1966, both dates inclusive, except from

(i) six o'clock in the afternoon of Monday to six o'clock in the forenoon of Tuesday; and

(ii) six o'clock in the afternoon of Tuesday to six o'clock in the forenoon of Wednesday of each week.

(c) From the 4th day of September, 1966, to the 10th day of September, 1966, both dates inclusive, except from

(i) seven o'clock in the afternoon of Monday to seven o'clock in the forenoon of Tuesday; and

(ii) seven o'clock in the afternoon of Tuesday to seven o'clock in the forenoon of Wednesday.

2. No person shall fish for sockeye or pink salmon in the waters of the southerly portion of District No. 3 embraced in Areas 17, 18 and 19 and in the waters of District No. 1 by means of nets:

(a) From the 26th day of June, 1966, to the 6th day of August, 1966, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Wednesday of each week; and

(b) From the 7th day of August, 1966, to the 20th day of August, 1966, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday of each week; and

(c) From the 21st day of August, 1966, to the 3rd day of September, 1966, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday of each week in the following described waters

(i) In the main Fraser River upstream to Mission Bridge from a straight line projected north and south magnetic through the Woodwards training wall west light near Steveston; and

(ii) In Canoe Pass upstream from a line projected north and south magnetic through Brunswick Cannery; and

(iii) In the Middle and North Arms upstream from Oak Street Bridge; and

(d) From the 4th day of September, 1966, to the 10th day of September, 1966, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday; and

(e) From the 11th day of September, 1966, to the 17th day of September, 1966, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday in the following described waters

(i) In the main Fraser River upstream to Mission Bridge from a straight line projected north and south magnetic through the Woodwards training wall west light near Steveston; and

(ii) In Canoe Pass upstream from a line projected north and south magnetic through Brunswick Cannery; and

(iii) In the Middle and North Arms upstream from Oak Street Bridge; and

(f) From the 18th day of September, 1966, to the 24th day of September, 1966, both dates inclusive; and

(g) From the 25th day of September, 1966, to the 8th day of October, 1966, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday of each week.

3. No person shall fish for sockeye or pink salmon except by angling or trolling for the purpose of personal consumption and not for sale or barter in the Convention waters of Canada, (the waters of Howe Sound excepted), lying easterly and inside of a straight line projected from Gower Point at the westerly entrance to Howe Sound to Thrasher Rock light, thence in a straight line to Salamanca Point on the southerly end of Galiano Island, thence in a straight line to East Point on Saturna Island, thence in a straight line towards Point Roberts light to the intersection with the international boundary line, thence following the international boundary line to its intersection with the mainland from the 21st day of August, 1966, to the 8th day of October, 1966, both dates inclusive, except at the times that net fishing other than with spring salmon nets may be permitted within that area.

All times hereinbefore mentioned shall be Pacific Daylight Saving Time."

United States Convention Waters

"The International Pacific Salmon Fisheries Commission appointed pursuant to the Convention between Canada and the United States of America for the protection, preservation and extension of the Sockeye Salmon Fisheries in the Fraser River System, signed at Washington on the 26th day of May, 1930, as amended by the Pink Salmon Protocol signed at Ottawa on the 28th day of December, 1956, hereby recommends to the Director of Fisheries of the State of Washington, that regulations to the following effect in the interests of such fisheries, be adopted by him for the year 1966 by virtue of authority in him vested by Section 6 of Chapter 112 of the Laws of the State of Washington of 1949, namely:

1. (1) No person shall fish for sockeye or pink salmon in the Convention waters of the United States of America lying westerly of a straight line drawn from Angeles Point in the State of Washington across Race Rocks to William Head in the Province of British Columbia with purse seines:

(a) From the 26th day of June, 1966, to the 30th day of July, 1966, both dates inclusive; and

(b) From the 31st day of July, 1966, to the 10th day of September, 1966, both dates inclusive, except from five o'clock in the forenoon to nine o'clock in the afternoon of Monday and Tuesday of each week.

(2) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with gill nets:

(a) From the 26th day of June, 1966, to the 30th day of July, 1966, both dates inclusive; and

(b) From the 31st day of July, 1966, to the 6th day of August, 1966, both dates inclusive, except from

(i) seven o'clock in the afternoon of Monday to nine o'clock in the forenoon of Tuesday; and

(ii) seven o'clock in the afternoon of Tuesday to nine o'clock in the forenoon of Wednesday; and

(c) From the 7th day of August, 1966, to the 10th day of September, 1966, both dates inclusive, except from

(i) seven o'clock in the afternoon of Sunday to nine o'clock in the forenoon of Monday; and

(ii) seven o'clock in the afternoon of Monday to nine o'clock in the forenoon of Tuesday of each week.

2. (1) No person shall fish for sockeye or pink salmon in the Convention waters of the United States of America lying easterly of a straight line drawn from Angeles Point in the State of Washington across Race Rocks to William Head in the Province of British Columbia with purse seines or reef nets:

(a) From the 26th day of June, 1966, to the 9th day of July, 1966, both dates inclusive; and

(b) From the 10th day of July, 1966, to the 1st day of October, 1966, both dates inclusive, except from five o'clock in the forenoon to nine o'clock in the afternoon of Monday and Tuesday of each week.

(2) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with gill nets:

(a) From the 26th day of June, 1966, to the 9th day of July, 1966, both dates inclusive; and

(b) From the 10th day of July, 1966, to the 6th day of August, 1966, both dates inclusive, except from

(i) seven o'clock in the afternoon of Monday to nine o'clock in the forenoon of Tuesday; and

(ii) seven o'clock in the afternoon of Tuesday to nine o'clock in the forenoon of Wednesday of each week; and

(c) From the 7th day of August, 1966, to the 1st day of October, 1966, both dates inclusive, except from

(i) seven o'clock in the afternoon of Sunday to nine o'clock in the forenoon of Monday; and

(ii) seven o'clock in the afternoon of Monday to nine o'clock in the forenoon of Tuesday of each week.

3. Section 2 above does not apply to sockeye or pink salmon taken in nets having mesh of not less than 8½ inches extension measure from the 26th day of June, 1966, to the 9th day of July, 1966, both dates inclusive, when and where such net fishing gear has been authorized for the taking of chinook salmon by the Director of Fisheries of the State of Washington.

4. No person shall fish for sockeye or pink salmon in the Convention waters of the United States of America lying westerly of a straight line drawn true south from the southeast tip of Point Roberts in the State of Washington (otherwise known as Lily Point) to the international boundary line from the 4th day of September, 1966, to the 10th day of September, 1966, both dates inclusive.

5. No person shall fish for sockeye or pink salmon in the Convention waters of the United States of America lying northerly and westerly of a straight line drawn from the Iwersen dock on Point Roberts in the State of Washington to the flashing white light on Georgina Point at the entrance to Active Pass in the Province of British Columbia from the 11th day of September, 1966, to the 1st day of October, 1966, both dates inclusive.

All times hereinbefore mentioned shall be Pacific Daylight Saving Time.

In making the above recommendations for regulatory control of sockeye and pink salmon fishing in the Convention waters of the United States of America for the year 1966, the Commission recognizes the need for the continued maintenance of certain preserves previously established by the Director of Fisheries of the State of Washington for the protection of other species of food fish."

Emergency Amendments

In order to provide for adequate racial escapements of Fraser River sockeye and for an equitable share of the season's catch by the fishermen of Canada and the United States, the approved regulations as detailed above were later amended on recommendation of the Commission. A detailed list of the regulatory amendments is as follows:

July 26, 1966 — Since the major part of the United States fishing fleet was operating in Alaska, an additional 24 hours fishing time was recommended for all United States Convention waters lying easterly of the Angeles Point-William Head line to achieve division in the allowable catch.

August 2, 1966 — In the interest of harvesting a greater portion of a substantial Chilko run, an additional 24 hours of fishing was recommended in all United States Convention waters and in Canadian Convention waters lying westerly of the Angeles Point-William Head line for the week commencing July 31.

August 3, 1966 — An additional 24 hours fishing time or a fourth day was recommended for the week commencing July 31 in all United States Convention waters because of continued good catches by a small United States fleet. Fishing in Canadian Convention waters lying westerly of the Angeles Point-William Head line was also extended by 24 hours.

August 4, 1966 — In the interest of equalizing the catch of sockeye between the fishermen of the two countries, and because of the indicated strength of the Chilko and Stellako runs, the Commission recommended an additional 24 hours or a fifth day of fishing in all United States Convention waters.

August 5, 1966 — To prevent an escapement of Chilko sockeye in excess of requirements, fishing was recommended in Canadian Convention waters lying easterly of the Angeles Point-William

Head line for 48 hours effective 8:00 a.m. Sunday, August 7.

August 9, 1966 — In view of the continued small size of the United States fishing fleet, 24 hours of additional fishing time was recommended in all United States Convention waters for the week commencing August 7. An additional 24 hours of fishing time was also recommended for all Canadian Convention waters lying westerly of the Angeles Point-William Head line.

August 10, 1966 — To allow a reasonable harvest of Fraser River sockeye, including the Adams River population, fishing in Canadian Convention waters lying westerly of the Angeles Point-William Head line was extended to a fourth day during the current week. In addition, fishing in all United States Convention waters was extended to five days to achieve division in the allowable catch.

August 11, 1966 — The Commission recommended that United States fishermen be allowed a sixth day of fishing, due to bad weather and a smaller than usual fishing fleet, to enable them to catch their allowable share of the current sockeye runs. In addition, a fifth day of fishing was recommended for the relatively small Canadian fishing fleet operating in Canadian Convention waters lying westerly of the Angeles Point-William Head line. To prevent too large an escapement to Chilko, fishing in the Fraser River lying easterly of the "Blue Line" was recommended for a third 24-hour period commencing at twelve o'clock noon Friday, August 12. The Commission also recommended that the Canadian Convention waters lying easterly of the Angeles Point-William Head line should not open as previously scheduled at 8:00 a.m. Monday, August 15 until improvement in the Stellako escapement had been observed.

August 16, 1966 — To aid in achieving division of the allowable catch, two additional days of fishing time or a total of four days were recommended for all United States Convention waters for the week commencing August 14. In Canadian Convention waters lying westerly of the Angeles Point-William Head line, fishing was restricted to three days. No sockeye fishing was permitted in Canadian Convention waters lying easterly of William Head during the current week because less than desired numbers of Stellako sockeye had been obtained for escapement. The Department of Fisheries of Canada opened the waters of the Fraser River lying upstream from the Brunswick Cannery-Oak Street Bridge boundary to fishing with 8½ inch mesh nets for 12 hours effective 8:00 a.m. Thursday, August 18, to permit

a reasonable exploitation of the current chinook salmon runs.

August 18, 1966 — Due to the disappointing upstream movement of Stellako sockeye, the opening of Canadian Convention waters lying easterly of the Angeles Point-William Head line for the week commencing August 21 was delayed until 8:00 a.m. Tuesday, August 23, fishing time in these waters being limited to 24 hours. All United States Convention waters were opened for fishing for an additional 24 hours or a fifth day to reduce the difference in allowable catch between fishermen of the two countries.

August 26, 1966 — Pending a full discussion with the Advisory Committee on Saturday, August 27, concerning the sharp decline in the Adams sockeye run the Commission advised that all Convention waters should remain closed for the first 24 hours of the previously scheduled fishing times for the week commencing August 28.

August 27, 1966 — All Canadian Convention waters lying westerly of the Angeles Point-William Head line were opened for 48 hours fishing effective Tuesday, August 30. Canadian Convention waters lying easterly of the Angeles Point-William Head line remained closed except for the waters of the Fraser River lying upstream from the Brunswick Cannery-Oak Street Bridge boundary which were opened for 24 hours effective 8:00 a.m. Wednesday, August 31. In addition, all United States Convention waters except the waters lying westerly of a line projected from Lily Point on East Point Roberts true south to the international boundary were opened effective Monday night, August 29 for 48 hours.

September 1, 1966 — Since there was almost a complete absence of Adams sockeye in all Convention waters except at Point Roberts and in Georgia Strait, regulatory control was relinquished effective September 4 in all Canadian Convention waters lying westerly of the Angeles Point-William Head line and in all United States Convention waters except those waters lying westerly of a line projected from Lily Point on East Point Roberts true south to the international boundary. In addition, all Canadian Convention waters lying easterly of the Angeles Point-William Head line were to remain closed for the week commencing September 4 except for the waters of the Fraser River lying upstream from the Brunswick Cannery-Oak Street Bridge boundary which were opened to fishing for 24 hours effective 8:00 a.m. Tuesday, September 6.

September 9, 1966 — The Commission agreed that all Canadian Convention waters lying easterly of the Angeles Point-William Head

line and the United States Convention waters lying westerly of the Lily Point line would remain closed for the week commencing September 11, to protect delaying Adams sockeye. The waters of the Fraser River lying upstream from the Brunswick Cannery-Oak Street Bridge boundary were opened by the Department of Fisheries of Canada to 9½ inch mesh nets for exploitation of chinook salmon for 12 hours effective 8:00 a.m. Tuesday, September 13.

September 16, 1966 — The Commission relinquished control in United States Convention waters lying westerly of a line projected from Lily Point on East Point Roberts true south to the international boundary except the waters lying northerly and westerly of a line projected from Iwersen dock on West Point Roberts towards Active Pass.

September 23, 1966 — In view of the strong upstream movement of Adams River sockeye in the Fraser River, the Commission decided to delay the decision on fishing time in Canadian Convention waters lying easterly of the Angeles Point-William Head line, including the Fraser River, until Monday, September 26. Since the catch of sockeye in the Point Roberts area of United States Convention waters was expected to be relatively small for the remainder of the fishing season the Commission relinquished regulatory control in these waters effective Sunday, September 25.

September 26, 1966 — Since the desired escapement of Adams River sockeye had been obtained, the Commission opened all Canadian Convention waters lying easterly of the Angeles Point-William Head line for 24 hours effective 8:00 a.m. Wednesday, September 28. At this time the Commission advised that regulatory control in the above waters would be relinquished Sunday, October 2, thus completing the Commission's regulatory obligations in Convention waters for the 1966 season.

SOCKEYE SALMON REPORT

The Fishery

The 1966 run of Fraser River sockeye was larger than anticipated on the basis of pre-season forecasts. The run totalled 4,760,764 sockeye of which 2,687,369 were caught commercially, 154,059 were taken by the Indian fishery and 1,919,336 were recorded on the spawning grounds (see Tables in Appendix). In general, all populations except Stuart and Seymour returned larger runs than had been expected on the basis of available data. While the economy of the fishery benefited substantially from the increase in the catch over that anticipated, the 1966 run was far below the established potential for this cycle.

Including estimates for that part of the Fraser run caught outside Convention waters, the 1966 sockeye population represented only 28 per cent of the population on this cycle in 1958.

The Chilko sockeye population, estimated at 950,000 adult fish, proved to be one of the main contributors to the 1966 catch. This run originated from only 8,923,000 smolts for a relatively high smolt-to-adult survival rate of 10.6 per cent. In view of the low survival rates of other major 1966 sockeye populations, an important question arises as to why the survival of Chilko fish was so favorable. The most logical answer lies in a possible shift in dominance which originated in 1959 as a result of unbalanced cyclical escapements. This subject was discussed in detail in the 1963 Annual Report. If dominance in the quadrennial production pattern of the Chilko population has shifted to the 1963-1967 cycle year — and evidence is available to indicate a good run in 1967 — the subdominant run would be expected to shift to the 1962-1966 cycle with a fall-off in the 1968 population. However, since the cause of dominance is not specifically defined and since survival rates vary for reasons other than those apparently associated with dominance, an exact prediction of the 1968 Chilko run cannot be made at this time. It is important to note than any decline in the Chilko run on the 1968 cycle year would have an important effect on the industry since a dominant Chilko population has maintained the catch on this cycle for several years.

The 1966 fishery was affected by several unusual occurrences. Gear efficiency, particularly that of purse seines and reef nets, was considerably below that of recent years. While gill nets operated effectively, their catch was not sufficient to compensate for the low efficiency of the other gear. The fish appeared to be scattered and deep during their daylight migration and extra fishing days were required in an attempt to provide for adequate harvest of the mid-summer runs. In 1962, 34.7 per cent of the Chilko run was caught in United States waters by a fishing fleet operating on a three- and four-day week. In 1966, with 64 per cent more purse seine effort and an 18 per cent increase in gill net effort operating five and six days per week on the peak of the run only 33.3 per cent of the Chilko run was taken in United States Convention waters.

The unusual timing of the Adams River run raised an additional management problem. Scale analysis of the catch indicated that a substantial peak in the Adams population occurred in Juan de Fuca Strait on August 10. Was this the peak of a much earlier run than normal or was it the beginning of a much larger run than expected? Catches of Adams River sockeye in Juan de Fuca Strait declined after August 10 to be followed by a sharp increase in abundance on August 20 and 21, the normal timing for the peak of the Adams run in this area. Since the run disappeared within two days after the second peak, the required escapement would have been seriously decimated if there had not been test fishing and other observations which accurately recorded this unusual arrival pattern and indicated the necessary fishing closures.

The portion of the Fraser River sockeye run migrating through Johnstone Strait was substantially greater than in recent years. In 1962, the brood year, an estimated 7.4 per cent of the total catch of Fraser River sockeye or 3.7 per cent

of the total run was taken in the Johnstone Strait fishery. In 1966, an estimated 17.8 per cent of the total catch or 10.9 per cent of the total run was taken in this area. The estimated portion of the Adams run approaching the Fraser River from the north was also greater than expected. In August 1966, sizeable gill net catches of sockeye near Goose Island in Queen Charlotte Sound were identified as being of Adams River origin, indicating a widely diverse landfall extending from Queen Charlotte Sound to Juan de Fuca Strait.

United States fishermen caught 1,337,000 Fraser River sockeye and Canadian fishermen 1,350,000 of the total of 2,687,000 — sharing the catch on a basis of 49.76 per cent and 50.24 per cent respectively (Tables I and II). The 1966 sockeye catch in Convention waters was 68 per cent greater than that of the brood year of 1962 and the total run showed an increase of 42 per cent. The average weight of four-year-old sockeye was 6.68 pounds, slightly greater than the cycle average of 6.43 pounds. Adams River sockeye averaged slightly over seven pounds.

The Canadian catch by gill nets and purse seines in Juan de Fuca Strait was up substantially over that of the brood year, due primarily to an increase in the mid-summer runs and early timing of the Adams River population. The portion of the total catch taken by Canadian gill nets in the Juan de Fuca Strait area continued to rise for the fifth consecutive cycle year, as shown in the following table:

Per Cent of Canadian Sockeye Catch Taken in Juan de Fuca Strait		*Per Cent of Canadian Sockeye Catch Taken by Purse Seines in Juan de Fuca Strait**		*Per Cent of Canadian Sockeye Catch Taken by Gill Nets in Juan de Fuca Strait**	
Cycle Year	*Per Cent*	*Maximum P.S. Units*	*Per Cent*	*Maximum G.N. Units*	*Per Cent*
1966	53.24	77	30.53	287	22.00
1962	35.94	74	19.97	311	15.77
1958	54.14	121	45.56	463	8.27
1954	36.42	139	33.68	101	1.86
1950	32.41	91	27.44	39	0.53
1946	13.49	84	12.52	9	0.08

*Troll catches not listed.

In United States Convention waters, the inability of the purse seines to harvest their normal share of the sockeye run is reflected by the decline in their portion of the catch from 66.57 in the previous cycle to 58.59 per cent in 1966 (Table II). The share of the season's catch taken by United States gill nets was the highest ever recorded for this cycle and the second highest in history, being exceeded only by their share in 1956. The reef net share of the season's catch was one of the lowest in history, dropping from 8.00 per cent in the brood year to 4.27 per cent in 1966. Significant declines have been recorded in the reef net catch for all cycle years and reflects a serious economic condition brought about by the increasing competition of mobile gear.

Escapement

The net escapement of 1,919,336 sockeye represented 40.3 per cent of the total 1966 run of 4,761,000 fish. The need for harvesting the large Chilko run to prevent excessive escapement resulted in overfishing other populations migrating at approximately the same time. Consequently, escapements of Gates, Big Silver, Seymour, Raft, Taseko and Stellako sockeye were below those of the brood year. However, in spite of extended fishing periods of up to five and six days per week in United States Convention waters, the 1966 Chilko escapement was larger than desired. The high smolt-to-adult survival rate of the Chilko population and the corresponding low survival rates of other sockeye populations are quite evident from the season's escapement records (Table VI). The management problem of regulating poor runs and good runs migrating at the same time is obvious.

In 1966, the total sockeye escapement was 296,000 above that of the brood year. Several factors were involved in this unplanned increase in escapement. The Commission's inability to permit a maximum harvest of the large Chilko run without seriously injuring the escapement to Seymour and Stellako Rivers, among others, allowed the Chilko escapement to increase to 227,000 sockeye from a brood year figure of 92,000 (Table VI), the latter figure being considered satisfactory for this cycle year.

A substantial increase of 73,000 fish also occurred in the escapement of three-year-old jack sockeye. Since jack sockeye, with few exceptions, are males, any escapement of these fish usually represents an economic loss. Unfortunately, the gill net fishery in Convention waters, particularly in the Fraser River, is unable to harvest jack sockeye because of their small size. For this reason, a much greater percentage of the jack sockeye run escapes to the spawning grounds. An effort has been made to catch jacks in the Fraser River with small mesh gill nets but the operation has not been successful since the smaller nets fail to harvest the larger and more abundant adult fish.

In view of the relative small size of the Adams River sockeye population, the planned escapement was reduced to a minimum of 1,000,000 to 1,200,000 sockeye or approximately equal to the brood year escapement of 1,151,000 fish. The actual escapement was 1,322,000 or about the same size as the 1950 spawning population which produced the large 1954 run. While the 1966 escapement to Adams River was somewhat greater than anticipated, due primarily to an increased percentage of the run approaching the Fraser River from Johnstone Strait, the number of spawners is far from excessive and considerably less than the 1954 escapement of 2,066,000 sockeye which produced the record-breaking 1958 run.

There has been a decided drop not only in the productivity of the Early Stuart sockeye population but also in the escapements of 1964, 1965 and 1966. The 1964 escapement of 2,400 sockeye represented a considerable decline from the brood year escapement of 14,600. In 1965, only 23,000 spawners were recorded compared with the brood year escapement of 201,000. Similarly, only 10,900 sockeye reached the spawning grounds in 1966 compared with 25,500 in 1962. These declines in recorded escapements have occurred in spite of favorable water levels for upstream migration and increased fishing restrictions.

Statistical analysis of the commercial fishery, when operative, and other data indicates that the numbers of Early Stuart sockeye escaping the commercial fishing area are considerably greater than the numbers reaching the spawning grounds. Although it is known that the Indian catch is increasing, data are not available to assign all of the fish disappearing between the commercial fishery and the spawning grounds to the increased Indian fishery. However, the Early Stuart sockeye escapements have been reduced to such a low level in recent years that the Commission can visualize no satisfactory answer to the problem other than the elimination of all fishing on this population, except for the limited Indian fishery in the Stuart Lake area. Until this run recovers to a satisfactory level of abundance, the temporary elimination of fishing during the Early Stuart migration through Convention waters and the Fraser River proper should not be a hardship for the Indians affected since their annual food supply can be harvested later in the season from the large runs of sockeye destined for other areas.

Water temperatures affecting both migrating and spawning sockeye were favorable throughout the 1966 season quite in contrast with temperature conditions in 1965.

Rehabilitation

Restoration of sockeye populations destroyed by the Hell's Gate obstruction, protection of populations subject to deterioration of spawning areas due to logging and other factors or whose spawning grounds have been eliminated in whole or in part by dams, and the increasing of fry production from areas with limited spawning grounds but with large and relatively unused rearing lakes all require development of artificial aids to reproduction. These artificial aids usually create new environments affecting the spawning and incubation period. However, unless these new environments produce fry capable of a high adult survival rate, little is accomplished.

Different species of salmon, and even different races within the same species, vary widely in their tolerance to changes in the reproductive environment. Most, however, are highly sensitive to environmental changes during spawning and incubation. This is indicated by the many failures and only occasional success recorded during the 86-year history of salmon hatchery operation in the western United States and British Columbia. It is well established that Fraser River sockeye are particularly rigid in their environmental requirements, hence a thorough knowledge of the dynamics of reproduction as related to the environment is essential not only for the proper development of artificial aids but also for management of naturally reproducing populations.

New scientific knowledge which may be applied to this problem accumulates at a relatively slow rate and so there is a constant temptation to undertake new rehabilitation methods strictly on a trial-and-error basis. The Commission has refrained from expanding on this basis but has proceeded to develop prototype experimental methods as new information has become available either through its own efforts or through the work of other fisheries research agencies.

Improvement of environmental conditions during the incubation period has been one of the methods for rehabilitation examined and tested rather extensively by the Commission. Since available knowledge indicated that the low survival rate of naturally incubated salmon eggs was due primarily to the hydraulic imperfection of the gravel medium, it was logical to assume that natural mortality tended to be non-selective during this period. Therefore, if hydraulic conditions could be improved without otherwise changing the environment it was hoped that the resultant increase in fry production would be reflected in an equivalent increase in the adult return. Such a situation would be in direct contrast to the case of hatchery-produced fry which usually have a decreased fry-to-adult survival rate sufficient to offset any benefits obtained by increasing survival to the fry stage.

In 1953 the Commission installed a small experimental gravel bed at Horsefly Lake where sockeye eggs were incubated and hatched. Water was supplied by a grid of perforated pipes laid under an 18-inch blanket of gravel. Egg-to-fry survival rates ranged from 20 to 68 per cent and averaged 51 per cent for the period from 1955 to 1958. However, the apparent landlocking of these young sockeye in Horsefly Lake resulted in abandoning the operation, hence it was impossible to assess the final benefits in terms of returning adults.

In 1960, the Commission established an experimental hatchery on Seven Mile Creek, tributary of Upper Pitt River, where measurements of natural fry production indicated that deterioration of the natural spawning grounds was so severe as to preclude maintenance of the native sockeye population. During the first three years of hatchery operation the fry produced were found to be inferior to wild fry, even though light had been eliminated during hatchery incubation and alevin development. In 1963, two connected upwelling-type incubation beds with a total area of 6,460 square feet were constructed adjacent to the hatchery. Eggs eyed in the darkness of the hatchery were planted in these areas and, in each of the following years, quality of the resulting fry has compared favorably with that from natural production.

The following table shows the operating record of the station since construction in 1960.

Sockeye Production at Pitt River Hatchery and Incubation Area

Brood Year	*Incubation Location*	*Eggs Spawned*	*Fry Produced*	*Per Cent Survival*
1960	Hatchery Only	3,257,000	2,508,000	77.0
1961	Hatchery Only	4,060,000	3,735,000	92.0
1962	Hatchery Only	1,357,000	1,126,000	83.0
1963	Hatchery, Incubation Area	3,189,000	2,417,000	75.8
1964	Hatchery, Incubation Area	3,700,000	3,256,000	88.0
1965	Hatchery, Incubation Area	2,133,000	1,776,000	83.3
1966	Hatchery, Incubation Area	3,658,000	?	?

Survival rates have been uniformly high and, in most years, the number of sockeye fry produced by the hatchery or the combined hatchery-incubation area has equalled or exceeded the estimated number produced naturally in the entire Pitt River watershed.

Although no attempt has been made to mark or identify the origin of returning adults, the returns to Seven Mile Creek should increase substantially if the operation is successful. The following table suggests that some success has been obtained from the hatchery even though the fry produced were considered inferior in quality until the incubation channel was installed in 1963. Pitt River sockeye mature at both four and five years of age in varying percentages from year to year. Thus the first year when the hatchery could have contributed to returns of both age classes was 1965. It can be noted that both the 1965 and 1966 adult returns showed a substantial increase in the percentage of the run returning to Seven Mile Creek, although other factors conceivably might have contributed to the increase. The true test of the experimental operation will come in 1967 and 1968 when the first adults return from fry originating in the incubation channel.

Pitt River and Seven Mile Creek Sockeye Escapements

Year	*Total Escapement to Pitt River Watershed*	*Seven Mile Creek Escapement*	
		Number	*Per Cent of Total*
1947	90,912	2,630	2.9
1948	53,000	2,124	4.0
1949	9,516	1,800	18.9
1950	42,800	10,577	24.7
1951	37,837	1,618	4.3
1952	48,887	7,416	15.2
1953	18,693	2,947	15.8
1954	17,624	891	5.1
1955	17,552	715	4.1
1956	32,258	3,559	11.0
1957	12,338	1,415	11.5
1958	10,385	785	7.6
1959	15,740	148	0.9
1960	24,511	587	2.4
1961	11,162	1,343	12.0
1962	16,585	971	5.9
1963	12,680	475	3.7
1964	13,804	1,338	9.7
		18-Year Average	*8.9*
1965	6,981	2,400	34.4
1966	20,866	8,000	38.3

Coincident with the beginning of the Horsefly experiment in 1953, the Department of Fisheries of Canada designed an artificial spawning channel for construction adjacent to Jones Creek. This channel was conceived as a substitute for pink and chum salmon spawning grounds endangered by the development of a hydroelectric project. Commencing in 1955, all of the run reproduced within the channel or in a few hundred feet of discharge flow extending from the channel to its confluence with the Fraser River. While there are several difficulties involved in assessing the total returns from each year's spawning, the essential point is that the pink salmon run produced each year is definitely larger than the original one observed in 1955, the first year of operation, and greater than several earlier runs observed by the Commission staff.

The following table presents the history of the Jones Creek artificial spawning channel since operations commenced in 1955.

Production Figures for Pink Salmon at Jones Creek, 1955 to 1966

Year	Total Spawners	Above Counting Fence			
		Spawners	Eggs Deposited	Fry Output	Per Cent Survival
1955	400	400	428,000	158,436	37.0
1957	1,456	1,056	947,000	363,169	38.3
1959	2,604	2,119	1,519,000	958,581	63.1
1961	5,088	4,388	3,789,300	1,055,176	27.8
1963	3,500	2,806	2,913,800	1,055,383	36.2
1965	3,000	2,088	2,175,200	1,370,000	63.0

A small artificial spawning channel adjacent to Seton Creek, constructed as a substitute for pink salmon spawning grounds flooded out by a hydro-electric diversion dam, has been described in detail in previous Annual Reports. Although some operating difficulties have occurred, these can certainly be eliminated. In 1963, the second cycle year of operation, a break in the control gate allowed excessive spawning in the channel and reduced egg-to-fry survival considerably. Although this situation has since been rectified, the problem of plant growth, which tends to seal the gravel interstices and also reduce survival within the channel, has not yet been completely overcome. The effectiveness of this channel, in terms of returning adults, will always be difficult to assess because of the large natural run spawning in that part of the creek not flooded by the power diversion dam. However, comparative tests show that the channel fry are similar in every respect to those produced in the stream, and survival to the adult stage has apparently been excellent. Since 1963, the pink salmon run returning to Seton Creek has tended to exceed all of the spawning capacity available and the number of spawners attempting to enter the channel has had to be restricted.

The following table presents an operating history of the Seton Creek spawning channel which has a capacity normally restricted to 7,000 adults.

Seton Creek Pink Salmon Spawning Channel

Brood Year	Spawners	Total Fry Produced	Per Cent Survival
1961	6,711	3,592,000	52.4
1963	14,106	3,480,000	21.7
1965	7,000	2,681,000	34.5

In 1965, an artificial spawning channel with a capacity for 20,000 sockeye salmon was constructed adjacent to Weaver Creek. Deterioration of the spawning grounds, associated with a sharp decline in the annual runs of this species, indicated that action was required if the Weaver Creek sockeye population was to be preserved at a commercial level. No attempt has been made to completely stock the channel at the expense of the natural spawning grounds in the creek, nor have chum or other species of salmon been denied entrance to the prepared

spawning grounds. In 1965, 4,441 sockeye, 50 pink and 1,186 chum salmon entered the channel mostly of their own volition. The egg-to-fry survival rate was a remarkable 68.4 per cent and 7,845,000 sockeye fry emigrated from the area in the spring of 1966. In 1966, 6,541 sockeye and 170 chum salmon spawned in the channel.

The adult sockeye return from fry produced in the Weaver Creek channel may never be measured exactly because an unknown number of fry and adults will continue to be produced from the creek. However, it is interesting to note that the egg-to-fry survival rate from the natural spawning grounds in Weaver Creek between 1951 and 1958 averaged only 5.4 per cent compared with 68.4 per cent survival of the 1965 brood which utilized the channel. Furthermore, with sockeye spawning populations in the creek as large as 36,200, the average annual fry production during the above period was only 2,200,000 compared with 7,845,000 fry from 4,441 channel spawners in 1965.

The fry-to-adult survival rate of Weaver Creek sockeye has been highly variable in the past, but the figures listed above demonstrate that fry from the channel, if equivalent to natural fry, should return a substantial run in 1969. Laboratory measurements of length and weight did not reveal any differences between the channel fry and those produced from spawning areas in the creek in 1965. Since no difference could be noted it is possible to consider the size of run which might return, assuming the survival rate of fry from the channel is equal to that of naturally produced fry. Based on measured survival rates for the years 1951 to 1956, the 1969 run produced by the channel alone could vary between 40,000 and 700,000 adult sockeye.

If the artificial spawning channel stands the test of time, as is already indicated by the Jones Creek project, and if the incubation channel on the Upper Pitt River watershed proves successful based on the approximate number of returning adults, two methods will be available to protect both sockeye and pink salmon from several of the adverse factors detailed earlier in this section. The artificial spawning channel has a higher initial capital cost and a much greater water demand and land requirement than the incubation channel, but the cost of operation is significantly less. Results to date indicate that the higher operational costs of the incubation channel may be offset by an average egg-to-fry survival rate at least double that recorded for channels where adults are permitted to spawn naturally. As stated in the 1965 Annual Report, these two methods are the only artificial aids available at the moment which have the potential to substitute for lost or deteriorating spawning grounds, or to successfully increase fry production when unused lake rearing potential is available.

While the use of hatcheries in the past has not proven economically successful in producing Fraser sockeye and pink salmon runs, the development of new diets and methods of disease control in recent years has made it possible to produce some outstanding results with coho and certain races of chinook salmon. The State of Washington has estimated that current adult returns from hatchery-propagated coho fingerlings reared to one year of age provide a benefit-cost ratio of three to one. The exact benefit-cost ratio for propagating and rearing certain races of chinook salmon is not yet available but it appears equally high.

Although young sockeye appear far less tolerant to environmental change than the fish referenced above, limited rearing experiments are now underway at Cultus Lake. Sockeye fry produced in an incubation channel are being used since they have been found to be superior to hatchery fry. The young sockeye initially will be reared for one year, or to the smolt stage, under controlled temperature conditions and fed the best diets known to fish culturists. This experiment will be continued until methods are found for producing a yearling smolt in excellent condition and having a sufficiently high adult survival rate to make the operation an economic success. Not only will this program expand the knowledge of requirements for successful smolt-to-adult survival but also will contribute eventually to extension of the sockeye fishery as required by the Commission's terms of reference.

Of the three artificial aids to reproduction detailed above, the incubation channel appears to have the greatest possibility for restoring sockeye populations destroyed by the Hell's Gate obstruction. It has a relatively low capital cost and can be operated on a temporary basis. Once its success is firmly established this method of restoring lost salmon populations will be expanded in the Fraser watershed.

Initially, starting in 1950, the Commission attempted rather extensive eyed-egg transplants to areas where sockeye populations had disappeared. These attempts to transplant runs by the transfer of eyed eggs to barren spawning areas met with only meager success. While there is no doubt that this rather inexpensive operation has more than paid for itself, with one exception the returns of these newly established runs have not shown any significant increase.

Perhaps the small runs now established will gradually adjust to their new environment and suddenly increase in some future year. This was the case of sockeye established in the Lake Washington system in the State of Washington. After over 20 years of mediocre returns the run suddenly increased to a substantial size. Nevertheless, on the Fraser River, neither the initial returns nor the runs produced through natural reproduction in later years have proven of great economic interest to the industry. Transfer of runs, which ultimately will prove to be of outstanding economic importance, remains a problem yet to be solved. The following is a record of some of the more successful sockeye transplants in the Fraser system:

Area Planted	*Donor Stream*	*No. of Eyed Eggs Transferred*	*Year of Return*	*Cyclical Returns of Spawning Adults*
Portage Creek	—	—	1950	Few Pairs
	Adams River	300,000	1954	3,505
	—	—	1958	4,803
	—	—	1962	12,034
	—	—	1966	31,844
Upper Adams River	—	—	1950	0
	Seymour River	667,000	1954	205
	Seymour River	495,000	1958	12
	Seymour River	1,333,000	1962	85
	—	—	1966	63
Middle Shuswap River	—	—	1954	0
	Adams River	1,396,000	1958	499
	—	—	1962	457
	—	—	1966	1,872
Eagle River	—	—	1958	31
	Seymour River	273,000	1962	169
	Seymour River	2,751,000	1966	277
Scotch Creek	—	—	1962	7
	Seymour River	1,023,000	1966	459
Fennell Creek	—	—	1959	0
	Raft River	490,000	1963	439
Barriere River	—	—	1957	0
	Raft River	550,000	1961	335
	—	—	1965	104

WATERSHED PROTECTION

In January 1966, construction was started on a low level fish pass on the left bank at Hell's Gate. River levels remained low throughout the winter months and construction was completed by March 15. Later in the year the effectiveness of the structure was checked and was found to be substantially as predicted from the hydraulic model. Inspection at low water at the end of the year showed that limited parts of the structure had been scoured by the river bed-load and minor repairs will be required, water levels permitting.

In May 1966, construction started on a second spawning channel adjacent to lower Seton Creek to accommodate approximately 21,000 pink salmon spawners. This channel is to be completed by March 1967 and will be in operation for the 1967 run.

Plans for a spawning channel for sockeye salmon adjacent to Gates Creek, tributary to Anderson Lake, were completed in preparation for construction during the current fiscal year. However, lengthy negotiations have been required with the Nequatque Indian Band by the government departments responsible

for obtaining land for the project. If funds are available, it is anticipated that construction can be started early in 1967, and the channel made operational in time for the large 1968 Gates Creek run.

Recommendations for remedial action to control water temperature in the Horsefly River sockeye spawning grounds were submitted to the governments in 1966. Detailed methods, considered to be practical and economically feasible, were presented for controlling water temperature to 57°F maximum at the sockeye spawning grounds in upper Horsefly River and in McKinley Creek. On the basis of experimental evidence, control of water temperature to this level should eliminate serious mortality of unspawned sockeye in this system. However, since conclusive verification cannot be obtained without prototype operation it is proposed to construct temperature control facilities on McKinley Creek at the outlet of McKinley Lake as a pilot operation. Further consideration will be given to construction of more extensive facilities at the outlet of Crooked Lake for temperature control in the Horsefly River and the construction of a fishway over Horsefly Falls after the effectiveness of the McKinley Creek project is established.

The results of studies concerning effects of the 1965 Stellako River log drive were published early in 1966. This was a cooperative study by the Commission and the Department of Fisheries of Canada, in collaboration with the Fish and Wildlife Branch of the British Columbia Department of Recreation and Conservation. It was found that the log drive created large bark and wood-fiber deposits in the river, caused accumulation of bark and wood debris within the gravel spawning beds, and that spawning grounds and river banks were eroded due to log jams and impingement of logs. Erosion of the spawning grounds was particularly severe in the lower part of the river and resulted in upstream displacement of sockeye spawners to areas which are already fully utilized by dominant cycle runs. On the basis of these findings, it was concluded that further damage to the spawning grounds should not be allowed, and it was recommended that the Stellako River should not be used for log driving. Despite these findings, logs were driven in the Stellako River in 1966 under order of the Minister of Lands, Forests and Water Resources for British Columbia. A survey of the effects of the 1966 drive was made by the British Columbia Research Council for the Provincial Government. The drive was also observed by staff of the Department of Fisheries of Canada and the Commission who cooperated with the Research Council in exchange of data collected. The 1966 drive resulted in additional erosion of the river banks, further deposition of bark upon and within the gravel stream bed, further erosion of the spawning grounds and continued displacement of spawners from the lower part of the river. The data obtained in 1966 substantiated the previous findings and conclusions published earlier, and the survey by the British Columbia Research Council did not contradict these findings.

The adverse and cumulative effects of continued log drives are quite obvious on the Nadina River, where logs were again driven down the lower river in 1966. Despite limitations on timing imposed to minimize scouring of the spawning grounds by logs, the annual succession of drives in this river and consequent log jams have created an unstable channel in lower Nadina River. The sockeye

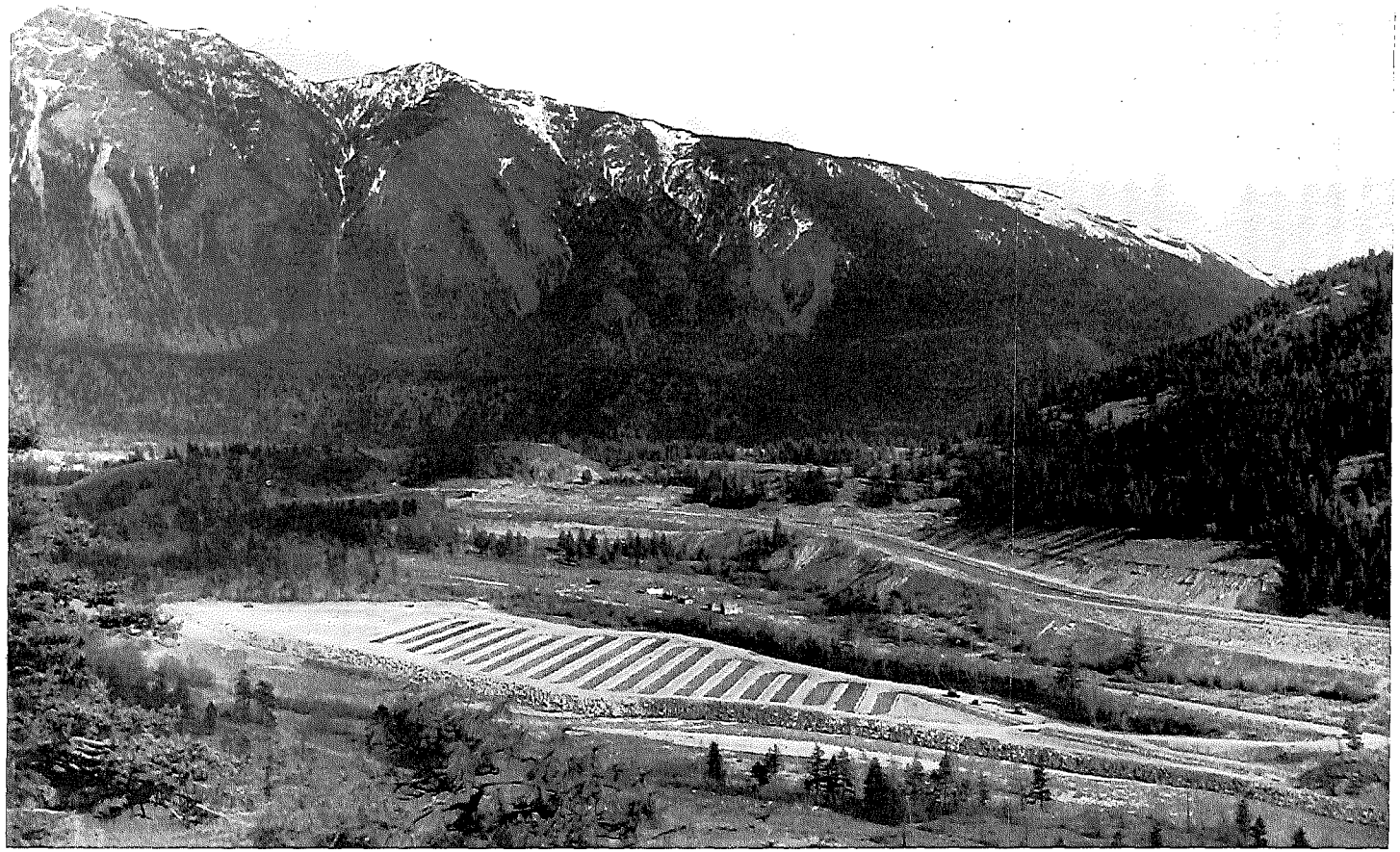

FIGURE 2 — A new Seton Creek Artificial Spawning Channel just completed and ready for the 1967 pink salmon run. The channel is 9,600 feet long, 20 feet wide and has a capacity for 21,000 spawners.

run no longer uses this historic spawning ground and the production per spawner of the run has declined significantly compared with the late run that spawns near Nadina Lake. In contrast, controlled log drives on the Tachie River, a much larger and quieter flowing river than either Stellako or Nadina, have not caused significant damage to the spawning grounds insofar as is now known. Similarly, the controlled log drives on the Quesnel River downstream from Quesnel Forks have not interfered to date with the salmon migrations on this river.

The pulp mill at Kamloops reached full capacity operation early in 1966, and except for a short initial period during which necessary operational procedures were developed, the waste treatment facilities have functioned properly and have more than fulfilled the requirements set by the Department of Fisheries. Two pulp mills at Prince George also started operating during the summer of 1966. Although the facilities at these mills have been shown to have the necessary treatment capability, continuing operational disturbances have resulted in frequent failure to meet the treatment requirements. Preliminary negotiations between the Department of Fisheries of Canada and a company planning a pulp mill at Quesnel established the principles of waste treatment to be employed.

Studies in connection with a sodium chlorate plant proposed for Prince George established that sodium chlorate was far more toxic to sockeye than was indicated by studies reported for other species of fish and that special provisions would be required for handling the fraction of this material to be discharged in the plant effluent. In collaboration with the Department of Fisheries of Canada the Commission also studied the effects on salmon of a proposed disposal of peat from Burnaby Lake to the Fraser River. Another study concerning the effects on salmon of the wastes from a paperboard plant is continuing. The Commission also participated with the Department of Fisheries in technical discussions concerning an oil refinery and a sulphuric acid plant proposed for construction near Prince George.

The pollution research program at the Sweltzer Creek Station continued its emphasis on monitoring of water quality in the Fraser River system and on studies examining the long-term effect of pollutants on sockeye salmon. The buccal cavity pressure technique, designed to provide rapid indication of low levels of stress on fish, was applied with promising results. Contract arrangements were made by the Department of Fisheries of Canada for the British Columbia Research Council to monitor the toxicity of pulp mill effluents, thereby relieving Commission scientists of this duty so that more time can be devoted to research.

1966 PUBLICATIONS

1. Annual Report of the International Pacific Salmon Fisheries Commission for 1965.

2. Research Bulletin Number XIX.
   Enumeration of Migrant Pink Salmon Fry in the Fraser River Estuary by E. H. Vernon.

3. Research Bulletin Number XX.
   Histological and Hematological Changes Accompanying Sexual Maturation of Sockeye Salmon in the Fraser River System by G. S. Colgrove.

4. Progress Report Number 13.
   Toxicity and Treatment of Kraft Pulp Bleach Plant Waste by J. A. Servizi, E. T. Stone and R. W. Gordon.

5. Progress Report Number 14.
   Effects of Log Driving on the Salmon and Trout Populations in the Stellako River. Prepared by the technical staffs of the Canada Department of Fisheries and the International Pacific Salmon Fisheries Commission in collaboration with the Fish and Wildlife Branch, British Columbia Department of Recreation and Conservation.

6. Progress Report Number 15.
   Occurrence and Control of *Chondrococcus columnaris* as Related to Fraser River Sockeye Salmon by D. J. Colgrove and J. W. Wood.

7. Administrative Report (restricted circulation).
   Proposed Artificial Spawning Channel for Gates Creek Sockeye Salmon.

8. Administrative Report (restricted circulation).
   Problems in Rehabilitating the Quesnel Sockeye Run and their Possible Solution.

TABLE I
SOCKEYE CATCH BY GEAR

United States Convention Waters

	Purse Seines			Gill Nets			Reef Nets			Total
Year	*Units*	*Catch*	*Percentage*	*Units*	*Catch*	*Percentage*	*Units*	*Catch*	*Percentage*	*Catch*
1966	187	783,466	58.59	384	496,295	37.11	40	57,086	4.27	1,337,215
1962	225	505,028	66.57	395	192,078	25.32	64	60,694	8.00	758,637
1958	368	4,259,324	81.02	689	844,602	16.06	82	152,158	2.89	5,257,316
1954	297	3,764,949	78.34	447	861,895	17.93	74	179,414	3.73	4,806,258

Canadian Convention Waters

	Purse Seines			Gill Nets			Traps			Total
Year	*Units*	*Catch*	*Percentage*	*Units*	*Catch*	*Percentage*	*Units*	*Catch*	*Percentage*	*Catch*
1966	77	405,585	30.04	1,484	922,831	68.35	0	0	0	1,350,154
1962	74	165,062	19.73	1,430	660,577	78.98	0	0	0	836,399
1958	180	2,541,592	48.49	2,275	2,680,914	51.15	3	14,241	0.27	5,241,617
1954	236	2,410,564	51.24	1,798	2,265,335	47.97	3	32,822	0.70	4,722,463

NOTE: Gear counts represent the maximum number of units delivering sockeye on any single day.
Unlisted troll catches of sockeye included in figures for total catch.

TABLE II

CYCLIC LANDINGS AND PACKS OF SOCKEYE FROM CONVENTION WATERS

	United States	*Canada*	*Total*
1966			
Total Landings (No. Sockeye)	1,337,215	1,350,154	2,687,369
Share in Fish	49.76%	50.24%	
Total Pack (48 Lb. Cases)	135,048	133,653*	268,701
Share in Pack	50.26%	49.74%	
1962			
Total Landings (No. Sockeye)	758,637	836,399	1,595,036
Share in Fish	47.56%	52.44%	
Total Pack (48 Lb. Cases)	72,235	78,047	150,282
Share in Pack	48.07%	51.93%	
1946-1966			
Total Landings (No. Sockeye)	34,287,535	33,646,991	67,934,526
Share in Fish	50.47%	49.53%	
Total Pack (48 Lb. Cases)	3,023,425	2,926,561	5,949,986
Share in Pack	50.81%	49.19%	
1966 *Cycle Catch*			
1966	1,337,215	1,350,154	2,687,369
1962	758,637	836,399	1,595,036
1958	5,257,316	5,241,617	10,498,933
1954	4,806,258	4,722,463	9,528,721
1950	1,220,893	894,469	2,115,362
1946	3,551,310	4,240,198	7,791,508
1942	2,935,192	5,047,599	7,982,791
1938	1,408,361	1,900,220	3,308,581
1934	3,590,058	1,430,300	5,020,358
1930	3,544,714	1,043,318	4,588,032
1926	469,900	912,566	1,382,466
1922	513,848	580,144	1,093,992
1918	569,094	242,275	811,369
1914	3,555,890	2,137,177	5,693,067
1910	2,765,726	1,690,091	4,455,817
1906	2,030,550	2,066,604	4,097,154
1902	4,001,717	3,177,538	7,179,255

*Includes 291 cases packed in Canada from sockeye caught in United States Convention waters.

TABLE III

DAILY CATCH OF SOCKEYE, 1954-1958-1962-1966 FROM UNITED STATES CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1954	1958	1962	1966	1954	1958	1962	1966	1954	1958	1962	1966
1	1,332						25,695	131,250	472,636	170,818		
2	6,000				30,780		16,883	104,089	446,988	326,983		
3					39,131			104,338	173,977	218,732	142	
4				CLOSED	40,284	27,722		56,763		182,785	897	
5	16,232				29,590	17,753		73,479		255,742	553	8,986
6	8,509				33,758	9,482	32,790		117,704	361,549	37,491	4,292
7	6,623						33,759		115,016	278,614	17,758	9,196
8	12,660						42,145	76,199	66,966	251,967		4,756
9	8,676	CLOSED	CLOSED		91,674			66,840	71,330	270,105		
10					105,771			40,168	42,100	99,657	331	
11				2,317	90,326	47,540		45,066	10,441	83,545	4,921	
12	22,095			1,968	97,704	52,692		51,407	7,646	74,324	5,584	3,262
13	18,854				46,749	48,236	41,499	26,894	8,952	71,025	542	980
14	10,979						13,444		8,796	100,305		1,686
15	10,248							44,307	10,409	44,837		511
16	12,450				36,495			43,556	2,412	22,421		
17					72,456			51,893	1,229	80,171		
18				6,902	39,634			22,143	635	13,319	452	
19	38,708			6,154	28,883			17,494	397	4,598	1,337	8,131
20	30,317				58,703	51,984	30,235		1,328		160	11,012
21	27,814	4,014				67,331	52,410		1,399			12,804
22	24,719	6,199			91,515	62,943		73,061	1,239	22,260		6,364
23	32,708	4,346	11,312		114,790			94,884	457	277,405		
24			12,930		83,238				308	6,769		
25			22,666	28,951	131,074	162,816			24	17,815	92	
26			25,538	34,784	154,114	116,752			358		800	145
27	74,196			41,679	232,693	156,081			401		93	186
28	51,039	19,972				195,990			430			33
29	43,155	10,697			406,321	218,385	183,264		159	42,564		8
30	35,233	8,253	53,588		291,987	249,106		11,044	96	145,499		30
31			33,591		359,793	173,652	52,971	6,457				
Totals	492,547	53,481	159,625	122,755	2,707,463	1,658,465	525,095	1,141,332	1,563,833	3,423,809	71,153	72,382
Troll and outside seine	3,566	26	388	75	32,348	1,092	426	287		109	23	
Monthly Totals	496,113	53,507	160,013	122,830	2,739,811	1,659,557	525,521	1,141,619	1,563,833	3,423,918	71,176	72,382
June, Oct. & Nov. Totals									6,501	120,334	1,927	384
Season Totals									4,806,258	5,257,316	758,637	1,337,215

TABLE IV

DAILY CATCH OF SOCKEYE, 1954-1958-1962-1966 FROM CANADIAN CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1954	1958	1962	1966	1954	1958	1962	1966	1954	1958	1962	1966
1	2,203	831						227,815	91,014	385,773		
2	250	1,695	2,469		152,014			102,476	152,294	466,479		
3			6,116		72,397			44,215	120,470	401,799	85,937	
4				9,042	34,165	22,502		48,348		458,172	50,972	
5	14,594			9,990	58,122	7,241			9,963	175,892	8,832	438
6	10,423				36,874	5,521	70,736		166,818		45,204	6,858
7	7,710	7,239					20,880	134,957	128,713		1,806	174
8	7,809	4,918						81,319	96,413	159,126		105
9	495	7,149	22,160		398			57,790	101,374	199,470		
10			11,310		3,731			76,573	148,585	141,025	53,283	
11			11,328	9,714	3,731	36,583		55,376		145,470	624	
12	9,652			2,539	3,732	13,238		102,303		130,616	349	174
13	8,436				398	14,050	5,801		206,257		173	16
14	7,172	14,098							151,204			511
15	7,135	11,789					33,515	46,027	180,631	2,486		
16	1,783	16,213	12,460		108,415			44,504	85	2,192		
17			12,708		92,423			48,046	569	1,974		
18				8,073	80,050				901	597	148	
19	18,778			5,050	55,805				904	307	172	760
20	12,751				6,313	105,922	39,664		356			71
21	10,854	12,140				241,232	28,275		606			903
22	15,976	6,642				284,595		70,477	313	119		
23	8,810	9,276	22,916		158,921			48,119	307	74		
24			7,351		235,021				97	66	725	
25				40,159	213,480	196,072			47,355	35	715	
26	71,411			15,177	539,669	219,024			15,658	789	784	530
27	41,306				265,408	339,029			10,204			56
28	33,001	19,301				315,589	50,144		19,086			7,668
29	33,306	9,497				195,690	26,674		9,287	1,198		
30	17,346	11,443	68,666		520,136		33,735	1,689	4,435	391		
31			18,324		48,441		25,720	7,233				
Totals	341,201	132,231	195,808	99,744	2,689,644	1,996,288	335,144	1,197,267	1,663,899	2,674,050	249,724	18,264
Troll and outside seine	3,356	350	790	2,603	10,283	3,373	4,417	18,950	103	1,131	291	35
Spring salmon gill nets							1,424	2,970		263	1,540	3,810
Monthly Totals	344,557	132,581	196,598	102,347	2,699,927	1,999,661	340,985	1,219,187	1,664,002	2,675,444	251,555	22,109
May, June, Oct. & Nov. Totals									13,977	433,931	47,261	6,511
Season Totals									4,722,463	5,241,617	836,399	1,350,154

TABLE V

THE INDIAN CATCHES OF SOCKEYE SALMON BY DISTRICTS AND THE VARIOUS AREAS WITHIN THESE DISTRICTS, 1962, 1966

	1962		1966	
District and Area	*Catch*	*No. of Fishermen**	*Catch*	*No. of Fishermen**
HARRISON-BIRKENHEAD				
Skookumchuck and Douglas	1,270	37	995	21
Birkenhead River and Lillooet Lake	10,863	56	3,905	35
Harrison and Chehalis	2,000	25	1,600	31
TOTALS	14,133	118	6,500	87
LOWER FRASER				
Coquitlam to Chilliwack	6,650	19+	18,032	
Chilliwack to Hope	23,235	109	43,060	
Vedder River and Vicinity	4,400	40	175	
TOTALS	34,285	168+	61,267	240**
CANYON				
Hope to Lytton	29,650	253	39,100	208
TOTALS	29,650	253	39,100	
LYTTON-LILLOOET				
Lytton to Lillooet	5,240	49	5,600	52
TOTALS	5,240	49	5,600	52
BRIDGE RIVER RAPIDS				
Rapids	7,860	74	8,400	78
Pavillion	1,100	31	2,750	56
TOTALS	8,960	105	11,150	134
CHILCOTIN				
Farwell Canyon	1,721	7	1,500	
Hances Canyon	2,252	9	494	
Alexis Creek	3,683	16	1,087	
Siwash Bridge	5,349	22	3,553	
Keighley Holes	1,797	8	1,918	
TOTALS	14,802	62	8,552	100
UPPER FRASER				
Shelley	155	3	87	14
Alkali and Canoe Creek	375	7	550	
Chimney Creek	2,375	45	505	
Soda Creek	840	16	370	
Alexandria	—		105	
Quesnel	600	11	240	
TOTALS	4,345	82	1,857	132
NECHAKO				
Nautley Reserve	2,266	15	1,839	19
Stella Reserve	1,999	19	2,340	19
TOTALS	4,265	34	4,179	38
STUART				
Fort St. James	3,697	64	1,352	37
Tachie, Pinchi and Trembleur Villages	1,952	38	1,502	56
TOTALS	5,649	102	2,854	93
THOMPSON				
Main Thompson River	2,575	148	10,600	98
North Thompson River	490	21	600	26
South Thompson River	10,200	107	1,800	119
TOTALS	13,265	276	13,000	243
GRAND TOTALS	134,594		154,059	

*Number of permits issued to Indians in district.

**45 of these permits transferred into the Canyon area.

The Indian catch statistics detailed above are obtained principally from the Protection Officers of the Department of Fisheries of Canada. These officers control the taking of sockeye for food by the Indian population residing throughout the Fraser River watershed.

TABLE VI

SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER RIVER SPAWNING AREAS, 1954, 1958, 1962, 1966

District and Streams	1966 Period of Peak Spawning	Estimated Number of Sockeye 1954	1958	1962	1966	Jacks	Sex Ratio Males 4-5 yr.	Females 4-5 yr.
LOWER FRASER								
Cultus Lake	Nov. 17-22	23,756	14,097	27,070	17,464	545	7,676	9,243
Upper Pitt River	Sept. 8-11	17,624	10,385	16,585	20,867	25	10,011	10,831
Widgeon Slough	Nov. 7-10	1,000	1,152	599	884	18	390	476
HARRISON								
Big Silver Creek	Sept. 25-28	279	——	490	329	0	164	165
Harrison River	Nov. 12-17	28,800	14,701	8,162	32,672	26	23,309	9,337
Weaver Creek	Oct. 14-19	28,773	36,199	15,962	20,416	927	9,351	10,138
LILLOOET								
Birkenhead River	Sept. 20-23	41,201	33,055	52,146	81,134	61,018	5,569	14,547
SETON-ANDERSON								
Gates Creek	Sept. 8-12	47	81	1,046	592	527	26	39
Portage Creek	Oct. 26-30	3,505	4,803	12,034	31,844	501	15,303	16,040
SOUTH THOMPSON								
Seymour River	Aug. 26-31	26,258	78,575	58,104	28,754	56	14,349	14,349
Eagle River	Sept. 1-4	4	31	169	338	1	193	144
Scotch Creek	Aug. 26-29	——	——	7	459	0	217	242
Anstey River	——	——	——	77	——	——	——	——
Upper Adams River	Sept. 12-15	205	Present	85	63	0	31	32
Lower Adams River	Oct. 19-28	1,532,820	1,730,609	984,447	1,180,105	35,021	518,438	626,646
Little River	Oct. 19-28	427,850	409,480	115,881	105,288	4,643	39,598	61,047
South Thompson River	Oct. 19-28	87,611	123,864	19,152	10,586	423	3,422	6,741
Lower Shuswap River	Oct. 13-16	17,462	9,387	31,205	24,629	214	10,987	13,428
Middle Shuswap River	——	0	499	457	1,872	0	936	936
Diverted Sockeye	——	0	1,006,177	0	0	0	0	0
NORTH THOMPSON								
Raft River	Aug. 29-Sept. 3	10,551	10,215	7,613	6,250	6	3,213	3,031
Barriere River	——	0	0	14	4	0	2	2
North Thompson River	——	——	——	90	46	0	23	23
CHILCOTIN								
Chilko River	Sept. 22-26	36,534	137,081	92,467	226,702	17,083	94,921	114,698
Taseko Lake	Aug. 28-Sept. 1	3,500	7,538	657	353	0	160	193
QUESNEL								
Horsefly River	Sept. 3-6	279	1,784	1,001	1,607	0	543	1,064
Mitchell River	——	18	65	5	142	0	71	71
Little Horsefly River	——	——	14	72	4	0	2	2
NECHAKO								
Endako River	Aug. 27-Sept 1	Present	522	236	5	0	2	3
Nadina River (Early)	Sept. 10-16	2,219	804	450	83	0	37	46
(Late)	Sept. 19-22			1,683	1,784	60	768	956
Nithi River	——	46	5	25	0	0	0	0
Ormonde Creek	Sept. 8-11	538	210	47	5	0	2	3
Stellako River	Sept. 26-Oct. 1	142,632	112,273	124,495	101,684	155	46,878	54,651
STUART								
Early Runs								
Ankwil Creek	Aug. 10-14	56	461	290	86	0	34	52
Driftwood River	Aug. 15-20	387	1,897	374	140	0	56	84
Dust Creek	Aug. 12-16	1,168	3,017	1,035	178	0	71	107
Felix Creek	Aug. 6-10	218	515	1,600	979	0	392	587
25 Mile Creek	——	207	218	25	0	0	0	0
15 Mile Creek	——	41	105	25	0	0	0	0
5 Mile Creek	——	5	111	11	0	0	0	0
Forfar Creek	Aug. 8-12	5,702	8,715	4,464	1,739	4	640	1,095
Frypan Creek	Aug. 10-14	266	57	243	58	0	23	35
Gluske Creek	Aug. 8-12	5,292	1,642	1,841	1,876	0	854	1,022
Kynoch Creek	Aug. 8-12	14,088	9,477	8,672	3,591	15	1,443	2,133
Narrows Creek	Aug. 10-12	2,756	1,823	666	322	0	148	174
Paula Creek	——	36	333	405	0	0	0	0
Rossette Creek	Aug. 8-12	3,836	3,735	4,887	1,645	10	675	960
Sakeniche River	Aug. 10-12	——	500	20	2	0	1	1
Sandpoint Creek	——	508	875	243	0	0	0	0
Shale Creek	Aug. 10-12	279	657	306	50	0	20	30
Misc. Streams	Aug. 10-16	23	492	339	193	0	77	116
Late Runs								
Kazchek Creek	Sept. 11-15	83	369	77	144	0	65	79
Middle River	Sept. 15-19	3,927	7,762	11,706	4,917	5	2,461	2,451
Pinchi Creek	Oct. 6-10	5	850	142	76	0	34	42
Tachie River	Sept. 25-30	1,529	13,738	6,764	3,600	0	1,627	1,973
NORTHEAST								
Upper Bowron River	Aug. 26-29	10,774	14,871	6,292	2,480	10	1,111	1,359
TOTALS*		2,484,698	3,815,826	1,622,960	1,919,336	121,293	816,457	981,586

*Totals include small numbers of fish in small tributaries not listed in the table.

TABLE VII

DAILY CATCH OF SOCKEYE, 1951-1955-1959-1963 FROM UNITED STATES CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1951	1955	1959	1963	1951	1955	1959	1963	1951	1955	1959	1963
1					57,324	53,990		112,848		2,556	23,297	
2	13,102				42,143	75,245		72,265	910		18,812	1,282
3	6,615				27,199	45,368	51,046		538			1,032
4	9,589	7,228					91,067		986	2,364		47
5	9,057	12,418					89,417	81,546	493	1,621		10
6	9,490	6,713			44,899		139,733	48,585	325	1,424		
7		3,409			27,696	48,429	167,337	29,274	137	703	5,401	
8			CLOSED		33,673	81,369	132,596	18,439		205	10,197	
9	23,677			CLOSED	19,943	54,024			265		7,266	28
10	10,244					40,503	93,493		1,254		11,143	439
11	8,156	7,824				25,131	124,278		33,599	330		421
12	6,570	8,251					80,698	37,789	6,580	255		
13	5,418	7,563			55,972		74,075	12,228	290	37		
14		7,265			39,260	30,632		14,300	138	131		
15					40,588	32,409				48	747	
16	16,435				39,036	31,554			149		495	
17	16,565				22,937	43,279	125,123		234		218	
18	12,476	16,903				27,280	83,286		109	142		32
19	13,501	17,687				2,222	64,087	6,193	109	70		6
20	14,630	13,795	7,112		9,835			4,269	285	76		
21		11,878	5,962		10,513	16,714		2,680	216	123	154	
22			5,008	33,394	7,992	12,623				77	99	
23	58,796			110,105	5,544	17,133	924		38		56	
24	59,917			130,412	2,162	10,967	125,615		9		8	
25	54,748	38,584		94,278		8,413	67,372		14	36		
26	45,817	13,949		92,026			17,846	2,648	7	6		
27	42,981	29,915	16,216	61,186	2,467		33,994	2,686	1	27		
28		30,647	20,278		7,489	10,136		2,330	2	45	1,941	
29			28,340	114,620	2,334	5,821		151		12	645	
30	64,435		44,671	121,644	1,346	5,372					553	19
31	79,869			104,333	853	4,307	29,018					
Totals	582,088	234,029	127,587	861,998	501,205	682,921	1,591,005	448,231	46,688	10,288	81,032	3,316
Troll and outside seine	5	10,011	437	240	6,756	63,702	4,188	203	53	757	27	1
Monthly Totals	582,093	244,040	128,024	862,238	507,961	746,623	1,595,193	448,434	46,741	11,045	81,059	3,317
June, Oct. & Nov. Totals										4,902	6,462	56
Season Totals									1,136,795	1,006,610	1,810,738	1,314,045

TABLE VIII

DAILY CATCH OF SOCKEYE, 1951-1955-1959-1963 FROM CANADIAN CONVENTION WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1951	1955	1959	1963	1951	1955	1959	1963	1951	1955	1959	1963
1					34,757	12,463				6,361	18,874	
2	24,501				50,315	53,491			52	486	19,749	11,459
3	16,133				14,127	44,447	15,439		32,198		6,740	8,062
4	13,850	8,734				41,692	16,614	91,288	15,955		1,581	10,160
5	14,078	13,388					5,000	70,820	12,617	22,777		106
6	1,500	9,539			63,292		Strike	54,485	10,675	17,051	3,831	
7		7,305			30,490		July 26	44,820	6	14,849	7,269	
8					33,448		Aug. 9	9,987		12,715	14,422	
9	20,406				29,668	64,348	Incl.		20	128	27,728	15,879
10	11,909				18,040	61,049	228,536		15,622		31,362	57
11	8,186	5,701				66,105	145,352		7,739		306	12
12	9,464	5,122				38,165	125,006	59,034	9,229	146		
13	3,000	5,984			59,457		127,041	27,942	12,047	31,216		
14		5,960			27,445			8,205	25	16,921	24,349	
15					13,579	41,061		5,783		29	22,769	
16	15,184			784	8,442	52,783			4	3	16,543	4
17	10,116			1,503	2,453	31,403	165,960		40,944		22,802	2
18	10,134	9,561				29,679	83,683		27,599		18	
19	13,384	7,827				16,703	41,091	43,585	19,424	9		
20	1,580	10,906	10,360		22,812			13,553	313	8		
21		20,569	8,871		10,325			3,146	54	1	19,365	
22			12,214	3,757	14,583	12,249		3,979		10	10,636	
23	38,081			6,900	16,428	27,296	55,943	1,955		1	19,305	15,557
24	30,178			22,877	392	24,536	104,920		24,783		15,459	
25	32,319	58,985		Strike		21,638	49,084		12,057			6
26	43,327	45,546		July 12	305	7,510	32,174	11,487	5,139			0
27	10,313	26,579	4,672	To	46,086			15,577				
28		14,064	2,540	Aug. 4	23,673			1,175			6	
29				19,241	17,925	4,356		1,276			2	
30	76,209			21,981	20,425	20,417		590			1	
31	39,931			47,394	228	10,126	31,096					
Totals	443,783	255,770	38,657	124,437	558,695	681,517	1,226,939	468,687	246,502	122,711	283,117	61,304
Troll and outside seine		534	2,163	1,673	1,541	39,667	21,458	5,028			608	3,057
8″ Gill nets			506	732						693	37	618
Monthly Totals	443,783	256,304	41,326	126,842	560,236	721,184	1,248,397	473,715	246,502	123,404	283,762	64,979
June, Oct. & Nov. Totals									37,641	7,189	8,398	21,145
Season Totals									1,288,162	1,108,081	1,581,883	686,681

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TABLE IX
SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER RIVER SPAWNING AREAS, 1951, 1955, 1959, 1963

District and Streams	1963 Period of Peak Spawning	Estimated Number of Sockeye 1951	1955	1959	1963
LOWER FRASER					
Cultus Lake	Dec. 3-7	13,143	26,000	48,461	20,571
Upper Pitt River	Sept. 4-8	37,837	17,552	15,740	12,680
Widgeon Slough	Nov. 1-5	745	—	637	353
HARRISON					
Big Silver Creek	Sept. 12-16	200	191	64	9
Harrison River	Nov. 12-18	17,145	5,595	28,562	22,287
Weaver Creek	Oct. 15-20	12,979	21,330	8,379	14,469
LILLOOET					
Birkenhead River	Sept. 21-25	55,862	25,355	38,604	67,151
SETON-ANDERSON					
Gates Creek	Aug. 25-29	—	86	867	4,858
Portage Creek	Oct. 23-27	30	43	572	2,011
SOUTH THOMPSON					
Seymour River	Aug. 25-29	24,344	9,511	52,325	71,690
Upper Adams River	—	0	0	0	6
Lower Adams River	Oct. 18-22	135,000	54,405	113,230	151,373
Little River	Oct. 20-25	9,690	9,072	21,080	5,148
South Thompson River	Oct. 20-25	500	0	472	45
Lower Shuswap River	Oct. 28-Nov. 5	0	23	0	23
NORTH THOMPSON					
Raft River	Aug. 24-28	8,561	5,364	10,210	8,724
Barriere River	Aug. 21-24	108	103	203	92
Fennell Creek	Aug. 23-27	—	—	27	439
North Thompson River	—	—	—	—	70
CHILCOTIN					
Chilko River	Sept. 16-20	118,110	128,081	470,621	1,002,252
Taseko Lake	Aug. 25-28	500	4,400	16,410	31,667
QUESNEL					
Horsefly River	Aug. 25-29	51	62	Present	86
Little Horsefly River	—	—	—	27	0
NECHAKO					
Endako River	Aug. 27-31	742	594	1,463	2,540
Nadina River (Early)	Aug. 24-28	326	202	351	1,019
(Late)	Sept. 14-18			1,013	7,304
Nithi River	Aug. 20-24	90	79	218	763
Ormonde Creek	Aug. 25-29	120	27	74	41
Stellako River	Sept. 23-27	96,200	51,971	79,355	138,805
STUART					
Early Runs					
Driftwood River	Aug. 14-18	50	0	3	14
Forfar Creek	Aug. 4-8	13,600	68	281	652
Frypan Creek	Aug. 4-8	50	0	1	4
Gluske Creek	—	3,787	99	97	0
Kynoch Creek	Aug. 1-5	32,825	1,029	1,123	2,147
Narrows Creek	Aug. 3-6	400	27	167	180
Rossette Creek	Aug. 1-5	10,000	916	911	1,600
Shale Creek	Aug. 4-8	190	0	2	9
Misc. Streams	Aug. 4-8	121	31	78	21
Late Runs					
Kazchek Creek	Aug. 20-24	200	18	7	364
Middle River	Sept. 17-21	2,000	3,596	3,500	1,838
Tachie River	Sept. 24-28	100	4,000	2,500	1,035
NORTHEAST					
Upper Bowron River	Aug. 23-27	21,770	9,355	29,247	25,144
TOTALS		617,376	379,185	946,882	1,599,484

TABLE X

DAILY CATCH OF PINKS, 1959-1961-1963-1965 FROM UNITED STATES CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1959	1961	1963	1965	1959	1961	1963	1965	1959	1961	1963	1965
1						34,070	52,307		187,274			
2						27,621	48,241	2,533	157,077		386,713	
3		34			6,110			1,312			215,316	
4		61			10,378			6,736			75,268	
5		38		84	13,181		68,013	15,117			61,129	
6				124	12,221		52,218					
7					13,229		40,441		108,145	CLOSED		108,690
8					9,036		30,906		153,233			68,470
9	CLOSED							14,502	133,600		103,803	27,983
10		494	CLOSED		10,105	64,389		11,818	132,028		193,448	
11		398			16,642			11,865			188,781	
12				674	17,634		102,743					
13				483	19,633		98,389					13,716
14							84,776					4,316
15						45,358			41,645			109
16						21,451		29,700	30,919			46
17		6,592			57,658			26,038	14,021			
18		8,234			41,664					4,023	91,403	
19		12,592		1,729	36,950		173,834			1,790	24,221	
20	1,063			2,504			166,400			1,265		6,185
21	1,533			2,272		72,620	181,808		8,427			2,036
22	1,127		7,831			51,641			8,204			2,099
23			19,156		10,524				4,195		26	2,402
24		25,288	17,490		316,210				1,134		41	
25		20,603	35,819		232,534			60,960		540	23	
26		18,595	27,844		59,823	CLOSED	427,506	46,508		463	14	
27	3,545		22,440		125,179		349,273			76		940
28	5,506			3,799			263,222		3,790			530
29	5,114		37,626	3,469			164,078		2,106			335
30	4,276		44,316						2,252		12,753	180
31		24,759	44,595		232,046							
Totals	22,164	117,688	257,117	15,138	1,240,757	317,150	2,304,155	227,089	988,050	8,157	1,352,939	238,037
Troll	40,259	20,449	133,114	21,986	126,019	40,671	327,235	53,630	6,545	1,683	20,550	1,832
Monthly Totals	62,423	138,137	390,231	37,124	1,366,776	357,821	2,631,390	280,719	994,595	9,840	1,373,489	239,869
June, Oct. & Nov. Totals									3,741	2,746	31,122	668
Season Totals									2,427,535	508,544	4,426,232	558,380

TABLE XI

DAILY CATCH OF PINKS, 1959-1961-1963-1965 FROM CANADIAN CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1959	1961	1963	1965	1959	1961	1963	1965	1959	1961	1963	1965
1						14,821			117,313			
2								10,495	89,335		67,539	
3		1						12,117	99,848		182,611	
4		1			13		5,237	10,252	19,653		210,058	
5			CLOSED				31,344			3,335	178,872	
6				3			57,540		95,733	2,198		
7				2			67,174		52,704			17,544
8							775		92,362			10,086
9	CLOSED					18,773		23,992	131,918		24,161	5,416
10		4			25,687	22,031		24,346	88,337		131,138	
11		4			24,563			25,866	9,774		91,215	
12		6		10	24,718		77,691			936		
13		29		10	34,625	4,954	86,575			569		6,151
14						3,753	81,750		29,041			4,110
15			STRIKE JULY 12 - AUGUST 4			80,913	106,538		57,720			3,383
16						56,892		49,953	45,086		14,390	3,314
17		13,807			40,111			43,342	37,960		8,865	
18		8,909			29,604			40,776	1,169			
19				22	1,749		142,007			344		
20	1,603			49			113,020			260		52,695
21	1,807			182		15,144	125,864		20,122	431		718
22	2,880					39,029	372,486		17,566			383
23	JULY 26 - AUG. 9				201,421		187,652		36,721		71,976	
24		27,564			225,659				22,104			
25		22,427			146,148			81,419			5,651	
26	STRIKE	18,841			98,483		12,340	37,969		89	1,790	
27				353			419,589			30		317
28				147		5,480	243,875		93	22		163
29				198		12,061	229,443		202			32,671
30				70			220,827	5,307	63			
31		9,097			123,443							
Totals	6,290	100,690	0	1,046	976,224	273,851	2,581,727	365,834	1,064,824	8,214	988,266	136,951
Troll	27,542	26,208	100,316	14,990	179,795	34,659	214,245	51,148	44,467	20,038	106,578	7,378
Spring salmon gill nets									482	37,330	12,894	13,508
Monthly Totals	33,832	126,898	100,316	16,036	1,156,019	308,510	2,795,972	416,982	1,109,773	65,582	1,107,738	157,837
June, Oct. & Nov. Totals									13,282	44,138	169,262	1,612
Season Totals									2,312,906	545,128	4,173,288	592,467

TABLE XII

SUMMARY OF THE PINK SALMON ESCAPEMENT TO THE FRASER RIVER SPAWNING AREAS

District and Streams	1965 *Period of Peak Spawning*	*Estimated Number of Pink Salmon* 1959	1961	1963	1965
EARLY RUNS					
LOWER FRASER					
Main Fraser	Sept. 28-Oct. 8	733,933	549,400	516,831	543,757
HARRISON					
Chehalis River	Oct. 10-16	6,729	11,921	12,394	7,621
FRASER CANYON					
Coquihalla River	Oct. 3-8	16,088	7,316	14,971	3,845
Jones Creek	Oct. 3-10	2,604	5,088	3,500	3,000
Lorenzetti Creek	Oct. 3-8	991	218	13	8
Silver Creek	Oct. 3-8	1,914	705	590	88
Hunter Creek	Oct. 3-8	234	140	254	13
American Creek	Oct. 3-8	790	147	307	75
Spuzzum Creek	Oct. 3-8	2,111	263	364	31
Nahatlatch Creek	Oct. 1-7	216	244	369	424
Anderson Creek	Oct. 3-8	567	166	676	31
Stein River	Sept. 29-Oct. 5	62	83	231	125
Churn Creek	Oct. 10-15	0	0	81	5
Watson Bar Creek	——	——	——	411	——
Texas Creek	——	195	0	——	0
Yale Creek	——	510	31	31	0
Emory Creek	Oct. 3-8	728	22	36	5
Stoyoma Creek	——	42	0	——	0
Kawkawa Creek	Oct. 3-8	1,279	502	104	31
Ruby Creek	Oct. 3-8	528	448	614	221
SETON-ANDERSON					
Seton Creek	Oct. 12-20	14,887	58,717	121,424	95,046
Portage Creek	Oct. 10-15	52	1,550	8,013	5,931
Bridge River	Oct. 7-12	1,201	1,895	6,422	23,657
THOMPSON					
Thompson River	Oct. 1-10	86,342	69,179	282,240	230,417
Nicola River	Oct. 1-5	806	216	1,196	894
Bonaparte River	Oct. 1-5	3	8	1,706	1,750
Deadman River	Oct. 1-5	0	8	101	39
Nicoamen River	—	73	0	0	0
TOTALS*		872,963	708,267	972,879	917,736
LATE RUNS					
LOWER FRASER					
Stave River	Oct. 20-24	1,383	3,994	910	226
Whonnock Creek	Oct. 20-24	57	278	255	34
Silverdale Creek	Oct. 20-24	68	88	151	3
Kanaka Creek	Oct. 20-24	18	23	3	5
HARRISON					
Harrison River	Oct. 16-23	110,311	186,137	645,476	69,213
Weaver Creek	Oct. 10-20	87	539	693	528
CHILLIWACK-VEDDER					
Chilliwack-Vedder River	Oct. 13-21	91,517	188,066	313,167	188,843
Sweltzer Creek	Oct. 18-23	751	6,224	15,215	8,908
Slesse Creek	Oct. 10-15	317	55	1,578	1,524
Tamihi Creek	Oct. 10-15	——	——	101	13
Middle Creek	Oct. 10-15	528	434	2,904	3,531
TOTALS*		205,037	385,838	980,453	273,387
GRAND TOTALS		1,078,000	1,094,105	1,953,332	1,191,123

*Totals include small numbers of fish in small tributaries not listed in the table.