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

1970

COMMISSIONERS

W. R. HOURSTON
RICHARD NELSON
RODERICK HAIG-BROWN
DeWITT GILBERT
THOR C. TOLLEFSON
CHARLES H. MEACHAM

NEW WESTMINSTER
CANADA
1971

INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION

MEMBERS AND PERIOD OF SERVICE SINCE THE INCEPTION OF THE COMMISSION IN 1937

CANADA

William A. Found	1937-1939
A. L. Hager	1937-1948
Senator Thomas Reid	1937-1967
A. J. Whitmore	1939-1966 1968-1969
Olof Hanson	1948-1952
H. R. MacMillan, C.B.E., D.Sc.	1952-1956
F. D. Mathers	1956-1960
W. R. Hourston	1960-
Richard Nelson	1966-
Roderick Haig-Brown	1970-

UNITED STATES

Edward W. Allen	1937-1951 1957-1957
B. M. Brennan	1937-1942
Charles E. Jackson	1937-1946
Fred J. Foster	1943-1947
Milo Moore	1946-1949 1957-1961
Albert M. Day	1947-1954
Alvin Anderson	1949-1950
Robert J. Schoettler	1951-1957
Elton B. Jones	1951-1957
Arnie J. Suomela	1954-1961
George C. Starlund	1961-1966
Clarence F. Pautzke	1961-1969
DeWitt Gilbert	1957-
Thor C. Tollefson	1966-
Charles H. Meacham	1969-1970

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DIRECTOR OF INVESTIGATIONS
LOYD A. ROYAL

NEW WESTMINSTER
CANADA
1971

DR. LOYD A. ROYAL

Director of Investigations of the International Pacific Salmon Fisheries Commission from 1950 until his retirement in February 1971. Dr. Royal joined the Commission 1949 as Chief Biologist and, following the death of Mr. B. M. Brennan, was appointed Director in 1950. His foresight and determination prepared a sound foundation for protection and management of the stocks of Fraser River sockeye and pink salmon.

REPORT OF THE
INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION
FOR THE YEAR 1970

With its responsibility to protect, preserve and extend the valuable sockeye and pink salmon fisheries of the Fraser River, this Commission must attempt to provide technical answers to ensure the fisheries do not suffer unnecessarily as the natural resources of the Fraser River Basin are developed. This responsibility is a monumental task. Even though the same problems have existed previously in other areas, and the Commission has had the benefit of data from those charged with similar responsibilities elsewhere, in many cases the problems have not yet been solved.

Each proposed project which may affect water within the Fraser River Basin and other parts of Convention waters is examined carefully, having in mind the previous experience of others. Where possible resource conflict is anticipated, the Commission attempts to find an answer or to provide the necessary scientific data to define the problem. The Commission then forwards its recommendations in respect to its terms of reference to either the Canadian or United States Government, whichever is most directly involved. The final decision rests with the people concerned and their government representatives. Obviously, the recommendations with their supporting data, like a presentation before a court of law, help determine the final decision. In many respects, it is this decision that directs the course of development and, fortunately, the maintainance of a desirable water ecology helps maintain a satisfying environment for the community.

In recent years, the Commission has been faced with a major pollution problem being created by rapid population growth and rapid expansion of a related industrial complex. For instance, five large pulp mills have either been built or are under construction in the Fraser River Basin. Since the discharge of domestic sewage in large streams has seldom, by itself, created a toxic or major stress factor on fish, this source of pollution has been considered to be more of a public health problem, up to the present time, than a threat to the fisheries. Because of this, the Commission has directed its research and recommendations primarily to the prevention of industrial pollution. A small staff of sanitary engineers and biologists was organized to conduct research and collect data for use by the Commission in meeting its responsibilities.

The past history of industrial pollution is quite clear. In earlier years, either the effluent was discharged without restraint, regardless of its toxic effects, or the waterways were considered a source for diluting the untreated effluent. Either practice frequently caused severe damage. Later attempts to set arbitrary water quality standards based on incomplete information caused confusion and frustration, not only to those responsible for preserving the fisheries and recreational resource, but also to industry as well.

Since these practices were unsatisfactory, the Commission adopted the principle that any effluent discharged in Convention waters should be nontoxic to sockeye and pink salmon before being discharged. The Canada Department of Fisheries

and Forestry has also adopted this same principle. New industry in the Fraser River Basin has been fairly reasonable in providing full treatment of industrial wastes, having in mind that any lesser pollution standard would end eventually in a chaotic situation, and without suitable environmental conditions, all efforts to improve the sockeye runs through increased fry production would be wasted.

The Commission, while empowered by the Sockeye Salmon Fisheries Convention to conduct fish cultural operations, recognized early in its existence that hatcheries left much to be desired as a means of increasing sockeye production. The great damage done to most of the upper river runs by the Hell's Gate obstruction had resulted in spawning escapements being well below the capacity of the spawning grounds, and the food supply of adjacent rearing lakes being greatly underutilized. In some streams, such as the Nadina River, the natural spawning areas were too limited in capacity to provide sufficient fry to utilize the available rearing capacity of the adjacent lake. In addition, logging and land clearing had caused localized deterioration of several smaller spawning streams.

Since the Commission was vitally interested in increasing fry production, the first investigations were directed towards isolating the reasons for hatchery fry being less viable and subject to a much higher mortality rate after release than that incurred by fry produced naturally. A conclusion was reached, after several years of investigation, that it was impossible to produce strong, healthy fry in the environment of even the most modern hatchery. Further investigations resulted in the development of artificial incubation and spawning channels as satisfactory methods for artificially increasing production of viable fry.

The success of the incubation and spawning channel in producing large increases in sockeye runs has been reported previously. In some instances the entire capital costs, plus interest, depreciation charges, and operating expenses, have been returned in one year of channel operation. However, the value of these projects depends on adjacent lakes which have sufficient rearing capacity to absorb the increased fry production. In certain large lakes in the Fraser Basin, the survival rate from fry to yearling smolts varies from 45 to 60 per cent under the natural lake conditions of predation and competition. It is the low operating expense of the channel, combined with the relatively high survival of fry to the smolt stage under natural conditions, which makes it possible for the channel to produce such a high dollar return. Since the sockeye is extremely sensitive to its reproductive environment, the success of the channel can only be assured at present where the original population is available and the water used has the same thermal environment as that utilized for natural reproduction.

Even though hatchery fry are weaker and smaller than those produced naturally or in artificial channels, modern pond rearing practices appear to compensate for these initial disadvantages for some species. Pond rearing of coho and chinook salmon as well as steelhead trout to migratory age has proven eminently successful in recent years. Declines in the relatively smaller runs of these species, caused mainly by adverse changes in the natural environment, have not only been halted by modern rearing operations but the same populations have been increased substantially.

Having in mind the possible future need for substituting both natural fry production and the required lake rearing area, the Commission for several years has conducted experiments in the pond rearing of sockeye at Cultus Lake. All of the knowledge accumulated in the design of successful rearing operations in the northwest United States has been gathered, and this information, combined with expert consultation, has guided the design of similar rearing operations utilizing Cultus Lake and other populations of Fraser River sockeye. Some of the difficulties encountered in rearing sockeye to the smolt or yearling stage have been eliminated. However, to date, all rearing experiments have proven unsuccessful apparently because of a greater sensitivity of this particular species to changes in its normal freshwater environment.

The foregoing illustrates in part the difficulties encountered in alleviating the adverse effects on Fraser River sockeye inherent in watershed development. Most, if not all, the potential problems created by industrial pollution can be avoided or solved with the cooperation of industry. Adverse environmental changes created by the removal of forest cover can be neutralized to some extent as far as sockeye and pink salmon are concerned by the use of artificial incubation and spawning channels.

In view of current interest in the hydroelectric potential of the Fraser River, the effects of such a development on the environment of the Fraser River and on the productivity of Fraser River sockeye and pink salmon becomes of paramount significance. Millions of dollars have been expended on studies of fish problems related to the construction of dams on the Columbia and Snake Rivers and to date no satisfactory solutions have been arrived at which would maintain salmonoid fishes in the Upper Columbia and Snake River Basins. Our studies show that the environmental changes which would result from the construction of a high dam or a series of smaller dams on the Fraser River below Prince George would be so massive in their effect on Fraser River sockeye that no artificial means are available to compensate for the destructive forces that would prevail.

The Commission considers it necessary under its terms of reference to report in detail to the proper government agencies on the unavoidable and disastrous effects the construction of a single high dam or a series of lower dams would have on the valuable Fraser River sockeye runs and ultimately on the economy of the fishing industry.

COMMISSION MEETINGS

The International Pacific Salmon Fisheries Commission held nineteen formal meetings during 1970 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 February 2 and 3 with Mr. W. R. Hourston serving as Chairman and Mr. DeWitt Gilbert as Vice-Chairman and Secretary. The Commission accepted the resignation of Mr. P. Jenewein who had

been an Advisory Committee member representing Canadian gill net fishermen since 1948. On February 3 the Commission met with its Advisory Committee composed of the following members:

United States	*Canada*
N. Mladinich Purse Seine Fishermen	F. Bublé Purse Seine Fishermen
R. Christenson Gill Net Fishermen	E. Arkko (temporary representative) Gill Net Fishermen
J. Plancich Salmon Processors	K. F. Fraser Salmon Processors
J. Brown Reef Net Fishermen	M. Guns Troll Fishermen
C. Mechals Troll Fishermen	H. Stavenes Purse Seine Crew Members
	R. Wright Sport Fishermen

The tentative recommendations for regulatory control of the 1970 sockeye salmon fishery in Convention waters, as submitted to the Advisory Committee by the Commission on December 16, 1969, were reviewed and certain revisions made on the basis of representations of the Committee.

On March 13, 1970 the Commission met in executive session to discuss administrative problems affecting the operation of the Commission. Mr. Roderick Haig-Brown was introduced as the new Canadian Commissioner replacing Mr. A. J. Whitmore who retired in 1969. The Commission recommended that the two separate regulations prohibiting net fishing for sockeye and pink salmon on the high seas portion of Convention waters, previously adopted in 1957, be replaced by a single regulation incorporating both species. Following approval by the two governments, the regulations were published May 28, 1970.

The third meeting of the year was held on May 27, 28 and 29. The Commissioners inspected Commission facilities at the Upper Pitt River Field Station, Weaver Creek spawning channel and the Sweltzer Creek Field Station, and visited the site of the proposed Chilliwack River pink salmon channel. Staff reports were given on the following subjects: 1. Experimentation with a new drug to prevent prespawning mortality of sockeye salmon, 2. Status of waste treatment systems being used in existing pulp mills, 3. Effect of decaying bark on sockeye eggs and fry, 4. Tests conducted in a stamina tunnel to assess the performance of sockeye smolts of various races, and 5. Results in long-term bioassays to determine the sublethal effects of copper on pink salmon eggs and alevins. In view of the recent success of artificial spawning channels the Commission approved an expanded construction program for increasing the sockeye and pink salmon runs, and in accordance with this policy, the Commission unanimously accepted the proposed budget for 1971-1972 which included an item of $400,000 for channel construction.

On June 29, a special meeting was held with representatives of the United States Department of Interior to discuss a brief submitted by the Makah Indian Tribe of Neah Bay, Washington. As a result of this meeting, the Commission recommended the United States Convention waters lying westerly of Angeles Point be opened on July 12 and be subject to the same fishing periods as prescribed for United States Convention waters lying easterly of Angeles Point.

Twelve formal meetings and several telephone conferences were required between July 21 and October 6 to achieve, by adjustment of fishing regulations, the desired escapement and equitable division of the allowable catch of Fraser River sockeye salmon and also deal with other subjects involving Commission operations. One of the referenced meetings, held on July 31, included members of the Advisory Committee. At this meeting regulatory problems related to the Chilko and Stellako sockeye runs were discussed. Mr. Frank Nishii was officially appointed as the Canadian gill net representative. The Commission also announced a four-year term for all newly appointed Advisory Committee members with reappointment subject to review by the Commission.

The seventeenth meeting of the year was held on October 17 with the Honourable Jack Davis, Minister of Fisheries and Forestry of Canada, Ambassador Donald L. McKernan, Assistant to the United States Secretary of State for Fisheries and Wildlife, and the Advisory Committee in attendance. The Commission discussed the renewed interest in the proposed Moran Dam on the Fraser River and requested that the 1958 report on potential fisheries losses and problems associated with the dam be updated and submitted to the two governments. The Commission also discussed the possible future use of thermal power plants and recommended a report be prepared in conjunction with the Canada Department of Fisheries and Forestry on potential locations for thermal plants which would avoid serious conflict with fisheries resources. Additional subjects discussed included: 1. A review of the 1970 sockeye run size and regulatory problems, 2. Status of construction of the Nadina River spawning channel, currently delayed due to problems in obtaining adequate funds from the United States Government, 3. Potential increase in sockeye production from several underutilized northern lakes through the use of artificial channels, and 4. Channel improvements at the Adams River. The Chairman announced the Commission's Director, Mr. Loyd A. Royal, had requested retirement effective March 1, 1971. An inspection was made of the Adams River spawning grounds and the channel changes made to increase fry production.

On November 30 the Commission held its eighteenth formal meeting of the year. Mr. Gilbert advised the Commission of the resignation of Mr. Charles Meacham as a United States Commissioner. The Commission discussed the difficult regulatory problems facing the Commission for the 1971 fishing season in view of the small predicted pink salmon run and the relatively large subdominant Adams River sockeye run which possibly would be migrating at the same time.

The nineteenth and final meeting of the year was held on December 17 and 18, with the first day devoted to general business and a special meeting with the Advisory Committee to consider the serious problem facing the Commission in

the management of the 1971 sockeye and pink salmon runs. The characteristics of the 1970 fishing season, the related escapements and spawning environment, and a summary of the possible factors influencing the size of the 1971 Fraser River sockeye and pink runs in Convention waters were discussed at the open meeting on December 18, attended by approximately 600 representatives of the fishing industry and other interested groups. Reports were also presented on the following topics: 1. Methods of attaining the full potential sockeye production in northern lakes, 2. Methods of channel management and operation, 3. Results of experimental treatment with the drug P7138 to prevent sockeye prespawning mortality, and 4. Comparison of pulp waste treatment methods in the Fraser system and elsewhere. Tentative proposals for regulating the 1971 fishery were released subject to further consideration by members of the industry and their representatives on the Commission's Advisory Committee. The industry representatives expressed their appreciation to Mr. Royal upon his coming retirement as Director after more than 22 years service.

1970 REGULATIONS

Recommendations for regulations governing the 1970 sockeye salmon fishery in Convention waters were adopted at a meeting of the Commission held on February 3, 1970 and submitted to the two national governments for approval and to the State of Washington for implementation on February 20, 1970. The recommendations for Canadian Convention waters were implemented by the Government of Canada by an Order-in-Council dated May 19, 1970 and for United States Convention waters by an Order of the Director of the Washington State Department of Fisheries on May 16, 1970.

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 1970, 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 that portion of Area 20 lying westerly of a straight line drawn true south from Sheringham Point Lighthouse to the International Boundary line with purse seines:

(a) From the 21st day of June, 1970 to the 25th day of July, 1970, both dates inclusive; and

(b) From the 26th day of July, 1970 to the 29th day of August, 1970, both dates inclusive, except from six o'clock in the forenoon to six o'clock in the afternoon of Monday, Tuesday and Wednesday of each week; and

(c) From the 30th day of August, 1970 to the 12th day of September, 1970, both dates inclusive, except from seven o'clock in the forenoon to seven o'clock in the afternoon of Monday, Tuesday and Wednesday 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 21st day of June, 1970 to the 25th day of July, 1970, both dates inclusive; and

(b) From the 26th day of July, 1970 to the 29th day of August, 1970, both dates inclusive, except from

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

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

(iii) six o'clock in the afternoon of Tuesday to six o'clock in the forenoon of Wednesday of each week; and

(c) From the 30th day of August, 1970 to the 12th day of September, 1970, both dates inclusive, except from

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

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

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

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 and 18 and in the waters of District No. 1 by means of nets:

(a) From the 28th day of June, 1970 to the 11th day of July, 1970, both dates inclusive, except for those sockeye or pink salmon taken in gill nets having mesh of not less than 8½ inches extension measure as authorized for the taking of chinook salmon by the Director of Fisheries for the Pacific Region and pursuant to the provisions of the British Columbia Fishery Regulations; and

(b) From the 12th day of July, 1970 to the 18th day of July, 1970, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday; and

(c) From the 19th day of July, 1970 to the 8th day of August, 1970, 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

(d) From the 9th day of August, 1970 to the 29th day of August, 1970, 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

(e) From the 30th day of August, 1970 to the 5th day of September, 1970, 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 the Canadian Pacific Railway 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 6th day of September, 1970 to the 12th day of September, 1970, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday; and

(g) From the 13th day of September, 1970 to the 19th day of September, 1970, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday in those waters described in subsection (e) of this section; and

(h) From the 20th day of September, 1970 to the 26th day of September, 1970, both dates inclusive; and

(i) From the 27th day of September, 1970 to the 10th day of October, 1970, 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 16th day of August, 1970 to the 30th day of September, 1970, both dates inclusive, except at the times that net fishing other than with chinook 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 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 to the United States Government that regulations to the following effect, in the interests of such fisheries, be adopted for the year 1970 and that an approved copy of said regulations be forwarded to the Director of Fisheries of the State of Washington for implementation 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 21st day of June, 1970 to the 25th day of July, 1970, both dates inclusive; and

(b) From the 26th day of July, 1970 to the 15th day of August, 1970, both dates inclusive, except from five o'clock in the forenoon to half past nine o'clock in the afternoon of Monday, Tuesday and Wednesday of each week; and

(c) From the 16th day of August, 1970 to the 12th day of September, 1970, both dates inclusive, except from five o'clock in the forenoon to nine o'clock in the afternoon of Monday, Tuesday and Wednesday 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 21st day of June, 1970 to the 25th day of July, 1970, both dates inclusive; and

(b) From the 26th day of July, 1970 to the 1st day of August, 1970 and from the 9th day of August, 1970 to the 15th day of August, 1970, all dates inclusive, except from seven o'clock in the afternoon of Monday to half past nine o'clock in the forenoon of Tuesday, from seven o'clock in the afternoon of Tuesday to half past nine o'clock in the forenoon of Wednesday, and from seven o'clock in the afternoon of Wednesday to half past nine o'clock in the forenoon of Thursday of each week; and

(c) From the 2nd day of August, 1970 to the 8th day of August, 1970, both dates inclusive, except from seven o'clock in the afternoon of Sunday to half past nine o'clock in the forenoon of Monday, from seven o'clock in the afternoon of Monday to half past nine o'clock in the forenoon of Tuesday, and from seven o'clock in the afternoon of Tuesday to half past nine o'clock in the forenoon of Wednesday; and

(d) From the 16th day of August, 1970 to the 22nd day of August, 1970 and from the 30th day of August, 1970 to the 5th day of September, 1970, all dates inclusive, except from six o'clock in the afternoon of Sunday to nine o'clock in the forenoon of Monday, from six o'clock in the afternoon of Monday to nine o'clock in the forenoon of Tuesday, and from six o'clock in the afternoon of Tuesday to nine o'clock in the forenoon of Wednesday of each week; and

(e) From the 23rd day of August, 1970 to the 29th day of August, 1970 and from the 6th day of September, 1970 to the 12th day of September, 1970, all dates inclusive, except from six o'clock in the afternoon of Monday to nine o'clock in the forenoon of Tuesday, from six o'clock in the afternoon of Tuesday to nine o'clock in the forenoon of Wednesday, and from six o'clock in the afternoon of Wednesday to nine o'clock in the forenoon of Thursday 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 nets from the 28th day of June, 1970 to the 11th day of July, 1970, both dates inclusive.

(2) No person shall fish for sockeye or pink salmon in that portion of the waters described in subsection (1) of this section lying inside of a line projected from Point Partridge to Smith Island Light to Lawson Reef Light to West Point on Whidbey Island with nets from the 12th day of July, 1970 to the 25th day of July, 1970, both dates inclusive.

(3) No person shall fish for sockeye or pink salmon in that portion of the waters described in subsection (1) lying northerly and westerly of a straight line drawn from Iwersen's 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 with nets from the 30th day of August, 1970 to the 5th day of September, 1970 and from the 13th day of September, 1970 to the 3rd day of October, 1970, all dates inclusive.

(4) No person shall fish for sockeye or pink salmon in that portion of the waters described in subsection (1) 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 with nets from the 6th day of September, 1970 to the 12th day of September, 1970, both dates inclusive.

(5) 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 12th day of July, 1970 to the 18th day of July, 1970, both dates inclusive, except from seven o'clock in the afternoon of Monday to half past nine o'clock in the forenoon of Tuesday, and from seven o'clock in the afternoon of Tuesday to half past nine o'clock in the forenoon of Wednesday; and

(b) From the 19th day of July, 1970 to the 25th day of July, 1970 and from the 2nd day of August, 1970 to the 8th day of August, 1970, all dates inclusive, except from seven o'clock in the afternoon of Sunday to half past nine o'clock in the forenoon of Monday, from seven o'clock in the afternoon of Monday to half past nine o'clock in the forenoon of Tuesday and from seven o'clock in the afternoon of Tuesday to half past nine o'clock in the forenoon of Wednesday of each week; and

(c) From the 26th day of July, 1970 to the 1st day of August, 1970 and from the 9th day of August, 1970 to the 15th day of August, 1970, all dates inclusive, except from seven o'clock in the afternoon of Monday to half past nine o'clock in the fore-

noon of Tuesday, from seven o'clock in the afternoon of Tuesday to half past nine o'clock in the forenoon of Wednesday, and from seven o'clock in the afternoon of Wednesday to half past nine o'clock in the forenoon of Thursday of each week; and

(d) From the 16th day of August, 1970 to the 22nd day of August, 1970, from the 30th day of August, 1970 to the 5th day of September, 1970, from the 13th day of September, 1970 to the 19th day of September, 1970 and from the 27th day of September, 1970 to the 3rd day of October, 1970, all dates inclusive, except from six o'clock in the afternoon of Sunday to nine o'clock in the forenoon of Monday, from six o'clock in the afternoon of Monday, to nine o'clock in the forenoon of Tuesday, and from six o'clock in the afternoon of Tuesday to nine o'clock in the forenoon of Wednesday of each week; and

(e) From the 23rd day of August, 1970 to the 29th day of August, 1970, from the 6th day of September, 1970 to the 12th day of September, 1970 and from the 20th day of September, 1970 to the 26th day of September, 1970, all dates inclusive, except from six o'clock in the afternoon of Monday to nine o'clock in the forenoon of Tuesday, from six o'clock in the afternoon of Tuesday to nine o'clock in the forenoon of Wednesday, and from six o'clock in the afternoon of Wednesday to nine o'clock in the forenoon of Thursday of each week.

(6) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with purse seines:

(a) From the 12th day of July, 1970 to the 18th day of July, 1970, both dates inclusive, except from five o'clock in the forenoon to half past nine o'clock in the afternoon of Monday and Tuesday; and

(b) From the 19th day of July, 1970 to the 15th day of August, 1970, both dates inclusive, except from five o'clock in the forenoon to half past nine o'clock in the afternoon of Monday, Tuesday and Wednesday of each week; and

(c) From the 16th day of August, 1970 to the 3rd day of October, 1970, both dates inclusive, except from five o'clock in the forenoon to nine o'clock in the afternoon of Monday, Tuesday and Wednesday of each week.

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

(a) From the 12th day of July, 1970 to the 18th day of July, 1970, both dates inclusive, except from

(i) twelve o'clock (noon) Sunday to half past nine o'clock in the afternoon of Sunday; and

(ii) five o'clock in the forenoon to half past nine o'clock in the afternoon of Monday; and

(iii) five o'clock in the forenoon of Tuesday to twelve o'clock (noon) Tuesday; and

(b) From the 19th day of July, 1970 to the 15th day of August, 1970, both dates inclusive, except from

(i) twelve o'clock (noon) Sunday to half past nine o'clock in the afternoon of Sunday; and

(ii) five o'clock in the forenoon to half past nine o'clock in the afternoon of Monday and Tuesday; and

(iii) five o'clock in the forenoon of Wednesday to twelve o'clock (noon) Wednesday of each week; and

(c) From the 16th day of August, 1970 to the 3rd day of October, 1970, both dates inclusive, except from

(i) twelve o'clock (noon) Sunday to nine o'clock in the afternoon of Sunday; and

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

(iii) five o'clock in the forenoon of Wednesday to twelve o'clock (noon) Wednesday of each week.

3. (1) The foregoing recommended regulations shall not apply to the following United States Convention waters:

(a) State Fishing Area No. 7 including all Convention waters known as Bellingham Bay lying inside of a line extending from Point Frances through the Post Point Bell Buoy to the mainland, and

(b) That portion of State Fishing Area No. 3 lying easterly and inside of a line projected from Carter Point on Lummi Island to the most northerly tip of Vendovi Island, thence to Clark Point on Guemes Island including the waters of Samish Bay, and

(c) Preserves previously established by the Director of Fisheries of the State of Washington for the protection of other species of food fish.

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

Emergency Amendments

In order to provide for adequate racial escapements of Fraser River sockeye salmon and for an equitable share of the season's catch by the fishermen of the United States and Canada, 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 2, 1970—As the result of a meeting held on June 29 to consider a brief submitted by the Makah Indian Tribe of Neah Bay, Washington, the Commission recommended the United States Convention waters lying westerly of Angeles Point be open to fishing on July 12 instead of July 25 as originally scheduled. Fishing times in these waters would be under the same regulations as those already approved for United States Convention waters lying easterly of Angeles Point.

July 21, 1970—Because of increased catches of Chilko sockeye by the test fishing boat in Juan de Fuca Strait, and in view of the small fleet operating in United States Convention waters, the Commission recommended an additional 24 hours fishing in all United States Convention waters for the current week.

July 31, 1970—Since the Fraser River sockeye escapement as of July 30 was below expectations and a minimum escapement of 300,000 Chilko and Stellako sockeye would be needed during the next two weeks, the Commission recommended the following fishing times for the week commencing August 2: 1. All Canadian Convention waters lying westerly of William Head open as originally scheduled but limited to two days fishing; 2. The opening of all Canadian Convention waters lying easterly of William Head be delayed for 24 hours with fishing being restricted to one day commencing at 8:00 a.m. Tuesday, August 4; 3. All United States Convention waters open as scheduled but limited to two days fishing.

August 4, 1970—In the interest of equal division of the catch the Commission recommended that an additional 24 hours fishing be granted for all United States Convention waters for the current week restoring fishing time in these waters to a total of three days as originally scheduled.

August 7, 1970—In order to obtain a more equitable division of the catch and increase the escapement the Commission made the following recommendations for the week commencing August 9: 1. Net fishing in Canadian Convention waters lying westerly of William Head be restricted to two days, with a 24-hour delay in the scheduled opening time; 2. Fishing by trollers in Canadian Convention waters lying westerly of William Head be restricted to the same fishing time as the net fishery in that area; 3. Fishing in Canadian Convention waters lying easterly of William Head be permitted for one day as previously scheduled but the opening time be delayed by 24 hours to commence 8:00 a.m. Tuesday, August 11; 4. Starting date of the originally scheduled troll restriction for the waters adjacent to the Fraser River be advanced one week to August 9 to protect delaying sockeye.

August 12, 1970—In an attempt to reduce the serious deficit in the United States catch the Commission recommended granting an additional 48 hours fishing in all United States Convention waters for the current week making a total of five days fishing. The Commission also recommended that because the required escapements of Chilko and Stellako sockeye had not been achieved, the opening of Canadian Convention waters lying easterly of William Head be delayed 24 hours with fishing for a 24-hour period to commence at 8:00 a.m. Tuesday, August 18.

August 14, 1970—In the interest of the division of catch between the fishermen of the United States and Canada the Commission recommended that the scheduled opening of fishing in all United States Convention waters for the week commencing August 16 be advanced 24 hours to Saturday, August 15 for reef nets and gill nets, and to Sunday, August 16 for purse seines.

August 18, 1970—In order to permit a greater escapement of sockeye through Juan de Fuca Strait and to aid in the division of catch the Commission recommended that fishing be restricted to two days in Canadian Convention waters lying westerly of William Head for the current week. Also, an additional 24 hours fishing was recommended for all United States Convention waters making a total of four days fishing for the current week.

August 21, 1970—Available evidence indicated that the Adams River sockeye run might be smaller than anticipated and that restricted fishing times were required. Therefore the Commission recommended the following regulatory changes: 1. Fishing in all United States Convention waters be postponed until 12:00 noon Wednesday, August 26 for reef nets, until 5:00 a.m. Thursday, August 27 for purse seines and until 6:00 p.m. Thursday, August 27 for gill nets, with fishing restricted to two days; 2. All Canadian Convention waters lying westerly of William Head be restricted to two days fishing commencing 6:00 p.m. Wednesday, August 26 for gill nets and 6:00 a.m. Thursday, August 27 for purse seines; 3. All Canadian Convention waters lying easterly of William Head be closed to fishing except for 24 hours commencing 8:00 a.m. Thursday, August 27 in those waters lying inside and easterly of a line extending from Point Grey to Point Grey Buoy thence to the light on the western end of the North Arm Jetty, thence to Sand Heads Light, thence to Canoe Pass Buoy, thence to the light on the western end of Tsawwassen Causeway and thence toward West Point Roberts Light to the International Boundary line, commonly known as the "Blue Line".

August 28, 1970—After reviewing all the current information pertaining to the Adams River sockeye run the Commission made the following recommendations in the interest of equitable division of the allowable catch and adequate escapement: 1. Effective August 30 the Commission would relinquish control in all Convention waters lying westerly of the Angeles Point-William Head line; 2. All United States Convention waters lying easterly of the Angeles Point line be closed for the week commencing August 30. Regulatory control of these waters to be relinquished September 6 with the exception of those waters lying westerly of the Lily Point line; 3. The Canadian Convention waters encompassed in Areas 17, 18 and District 1 be closed for the week commencing August 30 except for 24 hours fishing commencing 8:00 a.m. Wednesday, September 2 in the waters of District 1 including the Fraser River.

September 3, 1970—In the interest of escapement and to achieve equality in the season's catch between the fishermen of the two countries the Commission recommended that all Canadian Convention waters lying easterly of William Head be closed to fishing, except for 24 hours commencing 8:00 a.m. Tuesday, September 8 in those waters lying upstream from the Brunswick Cannery-Oak Street Bridge boundary.

September 9, 1970—The Commission reviewed the current status of the delaying Adams River population in the Gulf of Georgia and, because of the anticipated upstream movement of these fish

in volume by September 13-14, the Commission recommended that Canadian Convention waters lying within Areas 17, 18 and District 1 be closed effective September 12 until adequate escapement of Adams fish was obtained.

September 10, 1970—Observations and test fishing by the Commission's staff in the lower reaches of the Fraser River on September 10 indicated that very few Adams River sockeye were entering the Fraser River. On the basis of this information the Commission recommended a 24-hour fishery in those Canadian Convention waters lying upstream from the Brunswick Cannery-Oak Street Bridge boundary commencing 8:00 a.m. Friday, September 11 for the purpose of harvesting late migrating sockeye populations other than the Adams River run, with the closure announced September 9 to become effective 8:00 a.m. Saturday, September 12.

September 25, 1970—After reviewing the current status of the Adams River sockeye run currently moving up the Fraser River the Commission made the following recommendations: 1. Effective September 27 the Commission would relinquish control of all United States Convention waters lying westerly of the Lily Point line except for those waters lying westerly and northerly of the Iwersen Dock-Active Pass line. The Iwersen Dock line would remain in effect until October 4; 2. Fishing would be permitted in those Canadian Convention waters lying upstream from the Brunswick Cannery-Oak Street Bridge boundary for a 12-hour period from 7:00 a.m. to 7:00 p.m. Monday, September 28.

October 6, 1970—In order to harvest the late running portion of the Adams River sockeye run, considered to be undesirable spawners, the Commission recommended that all Canadian Convention waters lying easterly of William Head be opened to fishing for 24 hours commencing 8:00 a.m. Thursday, October 8 and that regulatory control be relinquished in these waters effective October 11.

SOCKEYE SALMON REPORT

The Fishery

The total 1970 Fraser River sockeye run, estimated at 6,131,000 fish, was 90.2% of the predicted run of 6,800,000. The number entering Convention waters totaled 4,991,000, of which 2,891,988 were caught commercially, 151,123 were taken by the Indian fishery, and 1,948,171 were recorded on the spawning grounds (see Tables I to VI in Appendix). The estimated catch of Fraser River sockeye in Johnstone Straits was 1,000,000 fish which represents 24.8% of the total commercial catch of Fraser sockeye in all areas, and 16.3% of the total run. The latter figure may be compared with catches of 4.03% of the total run in 1962 and 12.46% in 1966, the preceding two cycle years.

An intrusion of warm water along the West Coast of Vancouver Island was recorded early in the fishing season by the Fisheries Research Board Pacific Biological Station. Since thermal conditions in the landfall area of Fraser River sockeye are known to affect their approach characteristics, an increase in the number of sockeye approaching the Fraser River from the north was not surprising. However, this situation had not been expected in 1970 since it was not consistent with an inferred relationship between warm water intrusions and the sunspot cycle. The northerly diversion of sockeye, combined with a substantial increase in the high seas troll catch, adversely affected the net catch in Convention waters by reducing the number of fish available there.

While the total 1970 run approached the number predicted in advance of the fishing season, the summer run consisting mainly of Chilko and Stellako sockeye was only approximately 50% of that anticipated. The failure of these populations to return in expected numbers remains unexplained. The early season runs, including Early Stuart, approached expectations and the late run to Adams River was about 500,000 fish larger than anticipated. The Adams River population totaled approximately 4,000,000 sockeye or 65.2% of the total season's run. This run has increased in size each cycle year since the small run of 1962 and it is this increase which made the 1970 catch the largest for this cycle since the outstanding run in 1958.

The unusual migration characteristics of the 1970 run had a major influence on the fishery. The intrusion of warm water along Vancouver Island and the related increase in the number of fish approaching from the north has already been discussed. In addition, for the first time on record, the summer sockeye runs failed to appear in the Canadian high seas troll catches, yet they arrived as expected in the Juan de Fuca Strait net fishery where substantial numbers were caught. It cannot be determined whether these fish passed outside the troll fishery and entered Juan de Fuca Strait from the southwest, or whether environmental conditions prevented their capture by the troll fleet. By contrast, Adams River sockeye were taken in substantial numbers, it being estimated that Canadian trollers caught over 200,000 of these fish in 1970 compared with only 30,000 in the cycle year of 1966.

Normally, catches by the Canadian net fishery in Juan de Fuca Strait can be used to evaluate racial run size as the season progresses, based on the established relationship between the catch in this area and subsequent catches in the Salmon Banks area of United States Convention waters. Later, catches by the Fraser River gill net fleet are used to measure the efficiency of the United States fishing fleet which varies significantly from year to year. The 1970 catches in Juan de Fuca Strait indicated that the individual runs were larger than expected but the catch in the Salmon Banks area failed to respond accordingly. Additional fishing time was granted the United States fleet, based on the assumption that its efficiency was below average as has occurred occasionally in previous years. However, the Fraser River catch and the weekly escapement indicated a normal efficiency in the Salmon Banks-Point Roberts area showing that any vagary in the fisheries was occurring in Juan de Fuca Strait. It soon became evident that the Canadian net fishery was capturing milling rather than migrating sockeye in Juan de Fuca Strait, resulting in far greater catches than normal. Evidently this same situation occurred only once before in 1934.

Although the Juan de Fuca area was restricted to two days fishing each week, it was difficult to achieve an equitable division of the catch, particularly when Canadian fishermen also made an unprecedented one day catch of sockeye in Georgia Strait on September 2. Canadian fishermen harvested an excess of 191,554 sockeye over the catch taken by United States fishermen or 53.3% of the total Convention waters catch compared with 46.7% by United States fishermen.

Distribution of the 1970 catch by the several fishing gears was very similar in United States Convention waters to that of the brood year; purse seines harvested 57.7% (58.6% in 1966), gill nets took 37.4% (37.1%) and reef nets 4.9% (4.3%).

The percentage of the total Canadian sockeye catch taken in Juan de Fuca Strait and the high seas area of Convention waters increased significantly in 1970 to 63.1% compared with 53.2% in 1966. This large Canadian catch was caused by the troll fleet taking the highest percentage of the total catch ever recorded and the large net catches of milling fish at the entrance of Juan de Fuca Strait. In contrast, the Fraser River fishermen harvested 567,244 sockeye compared with 627,987 in the brood year.

Per Cent of Canadian Sockeye Catch Taken in the High Seas and 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*
1970	63.13	87	31.59	492	27.84
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.

The average weight of four-year-old sockeye was 6.13 pounds, significantly less than the cycle average of 6.41 pounds.

Escapement

The net escapement of 1,948,171 sockeye represented 39.0% of the 1970 run to Convention waters and 31.8% of the calculated Fraser River run. This escapement was approximately the same as that in 1966, the brood year, in total number of spawners, but there was considerable variation in escapement of individual populations (Table VI). Certain escapements in 1970 were quite satisfactory while others were substantially below the number required for adequate brood stock.

The first run of the season, destined for the Stuart Lake system, appeared in numbers approaching those anticipated and benefitted substantially from closures of both the commercial and Indian fisheries. This year's escapement of 34,566 Early Stuart sockeye was more than three times that of the brood year and equaled or exceeded all recorded escapements on this cycle except 1950. Favorable water levels prevailed in the Fraser River system during upstream migration and spawning of these fish. Similar favorable water conditions combined with severe restrictions of the fishery have increased recent escapements to the level that a moderate fishery on this population can be anticipated in those future cycle years when anticipated survival conditions justify such action.

The escapement of 1,341 spawners to the Bowron River system was unsatisfactory even for a small off-year cycle.

The escapement of 4,764 spawners to Nadina River was considerably larger than for any previous cycle year since at least 1917. Most were late run sockeye that spawn in a limited area just below the falls at the outlet of Nadina Lake. It is this population which will benefit substantially from the Nadina spawning channel now under construction (Figure 1).

The escapements to Stellako, Seymour, Raft, Chilko and Horsefly Rivers were reduced considerably from the brood year, primarily because the size of these runs was only 50% of expectation while the percentage taken by the fishery remained similar in both years. Normally, additional restrictions would have been placed on the fishery to compensate for the smaller runs in 1970. However, the Juan de Fuca Strait fishery, operating on milling fish, masked the small run size until it was too late to enact compensating regulations to obtain the desired number of spawners.

The decline in the Stellako escapement to 45,876 spawners was particularly disappointing since this has been the dominant cycle year of each quadrennial period for some time. Even though spawning conditions in Stellako River were favourable, the failure to secure a satisfactory number of spawners may prevent the 1970 cycle from remaining the largest of the quadrennial cycle.

The escapement of 1,502,681 sockeye to the Adams River area approached the estimated maximum number of spawners required for this system, although escapements were substantially larger in the earlier brood years of 1942, 1946, 1954 and 1958. With a more equal distribution of flow provided between the right and left bank channels in Adams River, as illustrated in the 1969 Annual Report, spawning and incubation conditions appear improved and it is believed that the egg-to-fry survival rate will be increased. The importance of maintaining a satisfactory escapement of this sockeye population is evident in the fact that this run produced 65.3% of the total 1970 Fraser sockeye run.

The dominant spawning escapement to Adams River has become famous as an educational and tourist attraction. Every fourth year on the 1970 cycle year over a million brilliantly colored sockeye spawn in the crystalline waters of Adams River blended with the autumnal coloration of the adjacent cottonwood and aspen trees. All of this together with brisk, clear fall weather and good access roads

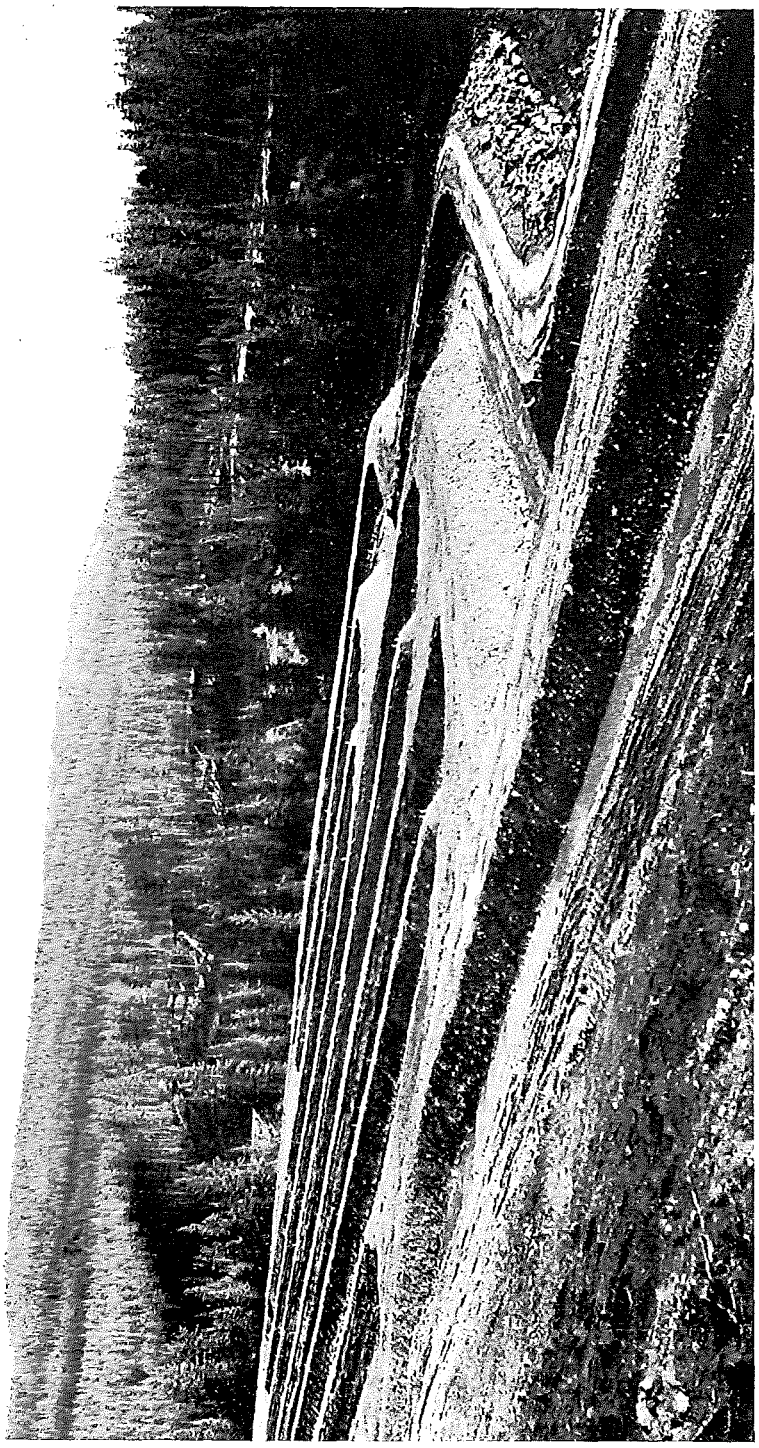

FIGURE 1—Nadina spawning channel under construction.

combine to make this a most spectacular sight. In 1970, fisheries agencies and organizations in British Columbia again presented the "Salute to the Sockeye Celebration" consisting of the construction of viewing sites with connecting trails, educational displays and other items of interest including fish cooking demonstrations and educational movies relating to the fisheries resource. Over 100,000 people, including many busloads of school children, visited the spawning area and display grounds during the month of October when spawning was under way. The attendance alone illustrates the tremendous public interest in this spectacular.

All of the sockeye populations produced in the lower river spawning grounds declined significantly from those produced in the brood year and the resulting escapements declined proportionately. The reduction in these runs was caused apparently by a low smolt-to-adult survival rate rather than by poor spawning, incubation or lake rearing environments. For instance, although over 2,100,000 smolts emigrated from Cultus Lake, the adult return was estimated at about 45,000 fish in 1970, representing a smolt-to-adult survival rate of only 2%. This may be compared with the Chilko smolt-to-adult survival rates which have dropped below 3% only twice in the past 18 years and have reached as high as 22%.

While the Adams River run showed a sizeable increase over those of the preceding two cycle years the Portage Creek population, transplanted initially from Adams River, declined drastically in 1970 and the outlook for the 1971 run is equally poor. This population built up gradually, beginning with a small return from a planting of eyed Adams River eggs in 1950 and reaching a spawning population totaling 31,844 sockeye in 1966. The 1970 escapement was down to 3,901 fish. Field investigations revealed no mining or industrial effluent, and no stream alteration which could explain the serious decline in the 1970 run or the similar decline expected in 1971. Determining the causative factor is further complicated by the sustained production of the Gates Creek run within the same watershed.

Rehabilitation

The fry population emerging from Weaver Creek channel in the spring of 1970 was the largest in the 5 years since the channel began operation in 1965. A record 32,600,000 fry were produced by the 17,089 adult sockeye which spawned in the channel in 1969. This large spawning population was approximately three times the size of any previous channel stocking. The egg-to-fry survival rate of 89.5% was also the highest recorded here, indicating that the initial design of the channel water supply and settling ponds has been effective, allowing continued high production rates without requiring extensive cleaning of the gravel.

The Commission has established that spawning and incubation channels represent a sound investment justifying an immediate and expanded program of development. However, since potential production from channels is so large, care must be used in managing a facility of this type. The potential of channel production is exemplified by the 1970 Weaver channel population of fry, which was 13 times the previous long-term average yearly production from Weaver Creek

natural spawning grounds. To put this in another way, it would have required an average of 205,000 spawners in Chilko River to produce the number of fry originating from only 17,000 spawners in Weaver channel.

One consideration in channel management must therefore be to evaluate the impact of increased fry populations on the capacity of the related lake rearing area. The 1970 fry production from Weaver channel, when combined with the estimated number of naturally produced fry in the system, formed a total of about 55,000,000 fry, approaching the calculated rearing capacity of Harrison Lake.

A second consideration in channel management concerns the eventual possibility of producing large numbers of fry *every* year in races which historically have shown major annual fluctuations in run size on a quadrennial cycle. If the release of large numbers of fry each year should prove to lower production by interfering with this cyclic dominance, better production rates in some areas may be obtained by operating the channel in only certain years of each four-year cycle. In this event, channel operation will continue to be profitable. Operating costs could be reduced and capital costs of channel construction will have already been recovered, as evidenced by the recent single year of adult returns to Weaver channel valued at $191,000 which reduced the capital cost of the project from $275,000 to a balance of only $84,000. The foregoing considerations, among others, indicate the continuing studies required in order to ensure maximum sustained production from channels.

The Weaver Creek adult run returning in 1970 was substantially smaller than that of the 1966 brood year and of the record 1969 run. The 1970 run to Upper Pitt River, supported mainly by an incubation channel, likewise was substantially smaller than that of the brood year. This reduction in run size was common to all runs of the lower Fraser River tributaries including several spawning runs supported solely by natural reproduction such as Cultus Lake and Harrison River. Egg-to-fry survival rate for this brood had been high at both the Weaver and Upper Pitt channels but as noted previously, monitoring of the Cultus race indicated a very low smolt-to-adult survival rate. Evidently the sparse runs to the entire lower Fraser River district were caused by a low smolt-to-adult survival rate, whatever the reason.

The adult returns in 1970 were of particular interest since several streams had previously received eyed-egg plants on this cycle. Although many of the experiments involving the transplantation of eyed eggs or advanced fry to barren streams failed to return any fish at all, there have been a few outstanding successes which have repaid the modest cost of the entire operation. Since Scotch Creek did not have a native sockeye run on the cycle year of the dominant Adams River run, 1,023,000 eyed Seymour eggs were planted in this stream in 1962. In 1966, 459 spawners returned to Scotch Creek and spawned in late August, the same timing as the native run which occurs in the 1961-1965 cycle year. Considering the commercial and Indian harvest of these fish the survival from this transplant was considered satisfactory. The important question was whether the new brood stock would be self-sustaining, hence the return of 359 sockeye in the 1970 cycle year was most satisfying, particularly when all similarly timed runs in 1970 suffered from a low smolt-to-adult survival rate.

A similar transplant of 1,396,000 eyed sockeye eggs of Adams River origin to Middle Shuswap River was made in 1954, the cycle year of the dominant Adams run. A total of 499 sockeye returned to this previously barren stream in 1958. These fish spawned naturally and this population was not stimulated further by additional transplantations. An escapement of 457 spawners returned in 1962, 1,872 in 1966 and 4,559 in 1970. This consistent cyclical increase in the size of the Middle Shuswap run is independent of the fluctuations in population size of the donor population and evidently it has become a self-sustaining run.

The most successful transplant in terms of a self-sustaining run resulted from planting Adams River eggs and fingerlings from the 1950 dominant cycle in Portage Creek, tributary to the Seton-Anderson Lake system. A total of 3,505 spawning fish were recorded in Portage Creek in 1954, and the cyclical return increased consistently thereafter until in 1966 a total of 31,844 spawners were observed. The decline in the 1970 escapement was discussed earlier, but the naturally produced increase for three consecutive cycle years presents strong evidence that this run has been established on a permanent basis.

These variations in the success of rehabilitation programs indicate the need for more information concerning the factors affecting survival, particularly during the migrant stage of fry, advanced fry, and smolts. Modern fish cultural procedures practically guarantee production of large numbers of apparently viable fry by increasing the egg-to-fry survival rate. Modern rearing methods have demonstrated that the rearing of coho and chinook salmon and steelhead trout fry is a sound economic operation. However, adult returns from reared fish vary from year to year, between rearing stations in the same year, and even between lots released from the same rearing station. All of this demonstrates the need for additional information on factors affecting survival of cultured salmonids as well as for naturally produced fish. Since so many ecological conditions occur during the changing existence of anadromous fish, this is a particularly challenging problem.

Research

In order to fulfill its terms of reference of protecting, preserving and extending the sockeye and pink salmon fisheries of the Fraser River, the Commission has established certain principles with regard to its investigational work. These principles are as follows:

1. To obtain and supply the necessary information to the respective governments when action may be required to protect the Fraser River sockeye and pink salmon fisheries.

2. To collect and collate the pertinent research data available from other agencies for application to the Commission's problems.

3. To initiate any new research that appears to be required and to stimulate other research groups to explore the same field in other areas.

The research efforts of the Commission have been divided into the three rather broad categories; management research, pollution, and physical engineering. This type of organization, operating under the above referenced principles, has proven

quite effective in dealing with the many fishery problems which accompany increasing watershed development, even though the size of the technical staff has been maintained at a relatively stable level for a number of years. A report of the staff's research operations for 1970 is submitted herewith.

A major part of the Commission's research activity on pink salmon is directed to measuring the varying environmental factors existing during freshwater and estuarial life history which appear to be related to eventual adult survival. Previous studies have indicated that although pink salmon fry production has been relatively constant, variation in subsequent survival has been the most important factor affecting the abundance of Fraser River pink salmon stocks. Research in 1970 was expanded towards obtaining more complete knowledge of the early sea life of the fry. Temperature, salinity, turbidity, and phytoplankton as well as fry abundance and their food supply were monitored regularly at 20 stations throughout southern Georgia Strait during the period of transition from fresh water to salt water. Under the conditions observed in 1970, the bulk of the pink salmon fry migrated northward from the river mouth, along the eastern shores of Georgia Strait. The small numbers of fry observed in the southern Gulf and San Juan Islands corroborated the evidence of the northward movement which is in contrast to the observations made in several preceding cycle years. The full value of these data will be realized when they are available for a sufficient number of years to establish a relationship to ultimate survival.

Research concerning sockeye populations of the Fraser system currently includes studies of all phases of the life history from spawning through freshwater development to smolt migration. These investigations, including studies of artificial culture, are described in the following paragraphs.

Coincident with the rehabilitation of certain major sockeye populations and the related increase in escapements, some populations have been plagued with serious prespawning mortalities. Losses are especially high among earlier than normal runs, among the early arrivals on the spawning grounds, and in years of warmer than normal water temperatures. Several studies over the last eight years have indicated possible methods of preventing this loss, but to date none have proven satisfactory. In 1970, experiments in chemical therapy were conducted on sockeye of the Chilko and Birkenhead runs using a nitrofuran drug developed in Japan. This drug had proved effective in controlling both columnaris and bacterial gill infections during salmonid rearing operations. Since the same pathogens are associated with prespawning mortality of sockeye, there was reason to believe that local use of this drug might control such losses. However, it was found that while the chemical was effective against *Chondrococcus columnaris* it did not prevent prespawning mortality. Further studies will be undertaken using a combination of controls, including temperature, in an attempt to reduce or prevent this economic disaster. In addition, studies are continuing on the physical and biochemical characteristics of adult spawners. Comparisons between populations or between differently timed segments of individual runs may indicate whether stress under specific circumstances contributes to premature mortality. Should prespawning mortality remain a problem, one alternative would be to construct artificial spawning channels with related temperature control facilities which could offset this loss by increasing fry production.

Probably the most complex study is that relating to the genetically controlled response of sockeye to their environment during the egg and fry stage. Earlier studies, which contributed to development of effective artificial spawning and incubation channels, included research on egg size, rate of development, timing of emergence, and fry migration behaviour and condition. Definite racial differences have now been established which will aid in the design of an improved program for rehabilitation or supplementation of runs. In addition, annual variation in egg size within the same population may indicate at least in part the survival potential of the fry.

Studies on the factors affecting fry emergence timing are now directed to the influence of temperature on the time required for yolk utilization and development during incubation. Although development is much accelerated at high temperatures, growth *per unit of temperature* is less than at lower temperatures. Recent studies of this "compensation" in rate of development at different temperatures indicate that each race examined to date appears to respond in the same general manner, although there is some difference between races in their ability to compensate for very low temperatures. All races compensated strongly to temperatures above 50°F and below 38°F. In another related study, results indicate that rate of development and time of fry emergence can be altered by several days by adjusting temperature at any time throughout the incubation period. These and other findings relate to the possible need for artificial temperature correction in spawning channels and provide a formula for doing so. They will also aid in properly assessing the effect of differences in temperature cycles between streams involved in egg transplants.

A study of the migratory behaviour of emergent fry, including those produced both naturally and artificially, shows that they follow a predetermined feeding migration. Insect larvae, usually Diptera, proved to be a major initial component in the fry's diet in both Harrison and Fraser Lakes. Once the availability of larvae declined the fry moved offshore and zooplankton formed the major part of their diet. As more data become available, the Commission can better assess the effect of food availability, growth, fry density, and timing on the fry-to-smolt survival in lakes and establish more precise formulae for lake stocking.

Present research is also directed toward understanding variations in the smolt-to-adult survival rate. Measurements of the Chilko sockeye population during several stages in its life history have revealed a smolt-to-adult survival rate varying from 1 to 22% over the past 20 years. While a high river flow at the time of smolt migration usually leads to a higher survival rate, it is not known if the flow itself is involved or whether some environmental condition related to flow affects the condition of the smolts. In order to understand this flow-smolt survival relationship better, a program has been undertaken to examine the condition of the smolt including physical measurements, fat analysis, screening for parasites and infections, seawater tolerance and stamina tests. Since various factors, notably temperature, have influenced the results of stamina measurements in field tests, correction formulae have now been developed from laboratory experiments and can be applied to previous and future data.

The Commission's research into the artificial culture of sockeye salmon has been carried out since 1949. The development of artificial spawning and incubation channels has been an important dividend from this effort. In addition to the incubation temperature studies described earlier, continuing investigations of channel incubation methods and substrate have been carried out to determine if egg-to-fry survival rates can be increased, and operational and maintenance costs can be decreased. Laboratory tests to date indicate that the gravel mixture now used in channels is superior to the use of larger stones both for survival rate and timing of fry emergence. Different approaches to egg planting have also been tested. Plants of green eggs gave adverse results with less than 60% of the eggs surviving to the fry emergent stage. However, plants of waterhardened eggs and eyed eggs both did equally well with a survival rate of about 90%.

Recent research on rearing sockeye from fry to the smolt stage has been seriously hampered by a viral infection, infectious hematopoietic necrosis (IHN). This infection appears to be the sole obstacle to a limited rearing operation for sockeye similar to the type which has been successful with coho and certain races of chinook salmon in the northwest states. Evidence obtained at the Western Fish Disease Laboratory in Seattle, Washington suggests the virus may be transmitted via the ovarian fluid from the female to its eggs rather than through the water supply. Further evidence suggests that at least some major sockeye populations reproducing above Hell's Gate may not be carriers, but that the virus may be localized in the sockeye populations inhabiting the lower watershed. The fact that Chilko Lake sockeye were successfully reared to smolts in 1970 using Cultus Lake water substantiates this hypothesis. All similar rearing experiments using Cultus Lake stock and Cultus Lake water were unsuccessful because of an outbreak of the infection. Recent experimental work at the Western Fish Disease Laboratory indicates that the virus can be killed by an organic iodine solution not harmful to eggs, hence all eggs collected from Cultus Lake sockeye in 1970 were treated with organic iodine to determine if this would permit a successful rearing experiment where all previous ones had failed. All other factors involved in the successful rearing of young sockeye including water supply, temperature, diet, feeding methods, pond design, and disease control have been defined. When the virus infection can be eliminated the Commission will be prepared to conduct a limited prototype experiment to measure smolt-to-adult survival rates of pond-reared fish and determine the value of this method for establishing new self-sustaining runs from transplants.

In the area of pollution study, recent research has been concerned with toxicity of heavy metals and pulp mill wastes. Mining operations and ore processing within the Fraser River watershed are controlled to prevent contamination of the adjacent waters but some heavy metals do reach the environment. Current research indicates that long-term exposure to copper during the egg-to-fry development period of sockeye and pink salmon causes mortality and abnormally slow yolk absorption at concentrations lower than those found lethal to fry and fingerlings. Other measurements show fingerling sockeye are stressed by copper at sublethal concentrations. Experiments involving mercury and cadmium indicate mercury to be far more toxic to developing sockeye embryos than to fingerlings, whereas the reverse is true for cadmium.

Although all kraft pulp mills operating on the Fraser River watershed have installed primary and secondary treatment of their wastes, this action alone does not guarantee that the treated wastes are not lethal when discharged into the receiving waters. Periodic monitoring of the toxicity of treated wastes reveals that occasionally the waste treatment systems fail to properly perform their function even though the biological oxygen demand of the waste has been reduced substantially. Materials passing through the treatment systems have been tested for identification and preliminary results indicate that residual toxicity may be related not only to operational problems but to the variable characteristics of the chip supply. This study directed towards treatment modification is being conducted in co-operatoin with Kamloops Pulp and Paper Company and the Forest Products Laboratory of the Canada Department of Fisheries and Forestry.

1970 PUBLICATIONS

1. Annual Report of the International Pacific Salmon Fisheries Commission for 1969.

2. Progress Report Number 24.
   Effects of Decaying Bark on Incubating Salmon Eggs by J. A. Servizi, D. W. Martens and R. W. Gordon.

3. Administrative Report (restricted circulation).
   Proposed Artificial Spawning Channel for Nadina River Sockeye Salmon.

TABLE I

SOCKEYE CATCH BY GEAR

United States Convention Waters

	Purse Seines			Gill Nets			Reef Nets			Troll		Total
Year	*Units*	*Catch*	*Per Cent*	*Units*	*Catch*	*Per Cent*	*Units*	*Catch*	*Per Cent*	*Catch*	*Per Cent*	*Catch*
1970	191	779,271	57.72	492	504,873	37.39	41	65,644	4.86	429	0.03	1,350,217
1966	187	783,466	58.59	384	496,295	37.11	40	57,086	4.27	368	0.03	1,337,215
1962	225	505,028	66.57	395	192,078	25.32	64	60,694	8.00	837	0.11	758,637
1958	368	4,259,324	81.02	689	844,602	16.06	82	152,158	2.89	1,232	0.03	5,257,316

Canadian Convention Waters

	Purse Seines			Gill Nets			Troll		Total
Year	*Units*	*Catch*	*Per Cent*	*Units*	*Catch*	*Per Cent*	*Catch*	*Per Cent*	*Catch*
1970	87	441,120	28.61	1,130	955,178	61.95	145,473	9.44	1,541,771
1966	77	405,585	30.04	1,484	922,831	68.53	21,708	1.61	1,350,154
1962	74	165,062	19.73	1,430	660,577	78.98	10,760	1.29	836,399
1958	180	2,541,592	48.49	2,275	2,680,914	51.15	4,870	0.09	5,241,617*

* Includes 14,241 trap caught sockeye.

NOTE: Gear counts represent the maximum number of units delivering sockeye on any single day.

TABLE II

CYCLIC LANDINGS AND PACKS OF SOCKEYE FROM CONVENTION WATERS

	United States	*Canada*	*Total*
1970			
Total Landings (No. Sockeye)	1,350,217	1,541,771	2,891,988
Share in Fish	46.69%	53.31%	
Total Pack (48-lb Cases)	125,903	146,033*	271,936
Share in Pack	46.30%	53.70%	
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%	
1946-1970			
Total Landings (No. Sockeye)	40,197,624	39,659,848	79,857,472
Share in Fish	50.34%	49.66%	
Total Pack (48-lb Cases)	3,518,692	3,448,897	6,967,589
Share in Pack	50.50%	49.50%	
1970 *Cycle Catch*			
1970	1,350,207	1,541,491	2,891,698
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 156 cases packed in Canada from sockeye caught in United States Convention waters.

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

NOTE: Pack figures include all sockeye landed even though some were sold fresh and frozen.

TABLE III

DAILY CATCH OF SOCKEYE, 1958-1962-1966-1970 FROM UNITED STATES CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1958	1962	1966	1970	1958	1962	1966	1970	1958	1962	1966	1970
1						25,695	131,250		170,818			31
2						16,883	104,089		326,983			6
3			CLOSED				104,338	79,718	218,732	142		
4					27,722		56,763	43,413	182,785	897		
5					17,753		73,479	35,355	255,742	553	8,986	
6					9,482	32,790			361,549	37,491	4,292	
7						33,759			278,614	17,758	9,196	549
8						42,145	76,199		251,967		4,756	301
9							66,840		270,105			671
10	CLOSED	CLOSED					40,168	70,672	99,657	331		275
11			2,317		47,540		45,066	55,718	83,545	4,921		
12			1,968		52,692		51,407	59,364	74,324	5,584	3,262	
13				4,133	48,236	41,499	26,894	67,530	71,025	542	980	
14				1,716		13,444		48,662	100,305		1,686	11,940
15							44,307		44,837		511	2,356
16							43,556	67,087	22,421			1,373
17							51,893	89,253	80,171			168
18			6,902				22,143	94,580	13,319	452		1,722
19			6,154				17,494	73,372	4,598	1,337	8,131	
20				14,399	51,984	30,235		52,020		160	11,012	
21	4,014			10,630	67,331	52,410					12,804	792
22	6,199			14,252	62,943		73,061		22,260		6,364	258
23	4,346	11,312		9,783			94,884		277,405			2,634
24		12,930							6,769			3,842
25		22,666	28,951		162,816				17,815	92		802
26		25,538	84,784		116,752					800	145	
27			41,679	47,077	156,081			234,354		93	186	
28	19,972			33,591	195,990			91,263			33	1,305
29	10,697			11,710	218,385	183,264			42,564		8	1,094
30	8,253	53,588			249,106		11,044		145,499		30	923
31		83,591			173,652	52,971	6,457	49				
Totals	53,481	159,625	122,755	147,291	1,658,465	525,095	1,141,332	1,162,410	3,423,809	71,153	72,382	31,042
Troll	26	388	75	57	1,092	426	287	365	109	23		1
Monthly Totals	53,507	160,013	122,830	147,348	1,659,557	525,521	1,141,619	1,162,775	3,423,918	71,176	72,382	31,043
June, Oct. and Nov. Totals									120,334	1,927	384	9,051
Season Totals									5,257,316	758,637	1,337,215	1,350,217

TABLE IV

DAILY CATCH OF SOCKEYE, 1958-1962-1966-1970 FROM CANADIAN CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1958	1962	1966	1970	1958	1962	1966	1970	1958	1962	1966	1970
1	831						227,815		385,773			933
2	1,695	2,469					102,476		466,479			167,484
3		6,116					44,215	84,815	401,799	85,937		
4			9,042		22,502		48,348	133,926	458,172	50,972		
5			9,990		7,241				175,892	8,832	438	
6					5,521	70,736				45,204	6,858	
7	7,239					20,880	134,957			1,806	174	107
8	4,918						81,319		159,126		105	5,627
9	7,149	22,160					57,790		199,470			61
10		11,310					76,573		141,025	53,283		
11		11,328	9,714		36,583		55,376	231,605	145,470	624		8,248
12			2,539		13,238		102,303	185,031	130,616	349	174	105
13				5,562	14,050	5,801				173	16	139
14	14,098										511	239
15	11,789					33,515	46,027		2,486			
16	16,213	12,460					44,504		2,192			
17		12,708					48,046	94,112	1,974			
18			8,073					103,304	597	148		
19			5,050						307	172	760	
20				9,883	105,922	39,664					71	
21	12,140			5,225	241,232	28,275					903	
22	6,642				284,595		70,477		119			
23	9,276	22,916					48,119		74			
24		7,351							66	725		
25			40,159		196,072				35	715		
26			15,177		219,024				789	784	530	
27				71,450	339,029			27,577			56	
28	19,301			45,779	315,589	50,144		4,850			7,668	150,254
29	9,497			21,227	195,690	26,674			1,198			
30	11,443	68,666				33,735	1,689		391			
31		18,324				25,720	7,233	1,975				
Totals	132,231	195,808	99,744	159,126	1,996,288	335,144	1,197,267	867,195	2,674,050	249,724	18,264	333,197
Troll	350	790	2,603	11,353	3,373	4,417	18,950	134,009	1,131	291	35	51
Spring Salmon Gill Nets				1,025		1,424	2,970	5,222	263	1,540	3,810	
Monthly Totals	132,581	196,598	102,347	171,504	1,999,661	340,985	1,219,187	1,006,426	2,675,444	251,555	22,109	333,248
May, June, Oct. and Nov. Totals									433,931	47,261	6,511	30,593
Season Totals									5,241,617	836,399	1,350,154	1,541,771

TABLE V

INDIAN CATCHES OF SOCKEYE SALMON BY DISTRICTS AND THE VARIOUS AREAS WITHIN THESE DISTRICTS, 1966, 1970

	1966		1970	
District and Area	*Catch*	*No. of Fishermen**	*Catch*	*No. of Fishermen**
HARRISON-BIRKENHEAD				
Skookumchuck and Douglas	995	21	400	8
Birkenhead River and Lillooet Lake	3,905	35	6,000	35
Harrison and Chehalis	1,600	31	600	12
TOTALS	6,500	87	7,000	55
LOWER FRASER				
Coquitlam to Chilliwack	18,032		7,475	63
Chilliwack to Hope	43,060		19,915	45
Vedder River and Vicinity	175			
TOTALS	61,267	240**	27,390	108
MIDDLE FRASER				
Hope to Lytton	39,100	208	47,990	302
Lytton to Lillooet	5,600	52	6,520	50
Bridge River Rapids to Churn Creek	11,150	134	33,425	300
TOTALS	55,850	394	87,935	652
CHILCOTIN				
Farwell Canyon	1,500		700	20
Hances Canyon	494		348	34
Alexis Creek	1,087		1,029	26
Siwash Bridge	3,553		1,527	40
Keighley Holes	1,918		302	
TOTALS	8,552	100	3,906	120
UPPER FRASER				
Churn Creek to Chimney Creek	550		1,800	78
Soda Creek	875		500	39
Quesnel	345		325	27
Shelley	87	14	107	21
TOTALS	1,857	132	2,732	165
NECHAKO				
Nautley Reserve	1,839	19	1,240	14
Stella Reserve	2,340	19	2,883	21
TOTALS	4,179	38	4,123	35
STUART				
Fort St. James	1,352	37	977	29
Tachie, Pinchi and Trembleur Villages	1,502	56	1,975	48
TOTALS	2,854	93	2,952	77
THOMPSON				
Main Thompson River	10,600	98	11,735	280
North Thompson River	600	26	750	33
South Thompson River	1,800	119	2,600	105
TOTALS	13,000	243	15,085	418
GRAND TOTALS	154,059		151,123	

* Number of permits issued to Indians in district.

** 45 of these permits transferred into the Hope to Lytton area.

The Indian catch statistics detailed above are obtained principally from the Conservation Officers of the Department of Fisheries and Forestry 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, 1958, 1962, 1966, 1970

District and Streams	1970 Period of Peak Spawning	Estimated Number of Sockeye				Jacks	Sex Ratio	
		1958	1962	1966	1970		Males 4-5 yr.	Females 4-5 yr.
LOWER FRASER								
Cultus Lake	Nov. 15-20	14,097	27,070	17,464	15,149	1,208	5,778	8,163
Upper Pitt River	Sept. 14-17	10,385	16,585	20,867	6,657	15	3,414	3,228
Widgeon Slough	Nov. 2-5	1,152	599	884	364	3	203	158
HARRISON								
Big Silver Creek	Sept. 28-Oct. 1	—	490	329	261	37	112	112
Harrison River	Nov. 27-30	14,701	8,162	32,672	12,675	9	6,147	6,519
Weaver Creek	Oct. 24-28	36,199	15,962	20,416	11,096	661	5,183	5,252
LILLOOET								
Birkenhead River	Sept. 24-26	33,055	52,146	81,134	72,760	42,104	9,847	20,809
SETON - ANDERSON								
Gates Creek	Aug. 30-Sept. 1	81	1,046	592	803	725	47	31
Portage Creek	Oct. 31-Nov. 2	4,803	12,034	31,844	3,901	28	1,709	2,164
SOUTH THOMPSON								
Seymour River	Sept. 6-10	78,575	58,104	28,754	14,375	20	7,233	7,122
Eagle River	Sept. 8-11	31	169	338	23	0	10	13
Scotch Creek	Sept. 1-3	—	7	459	304	0	137	167
Anstey River	Sept. 8-11	—	77	—	196	0	88	108
Upper Adams River	Sept. 7-9	Present	85	63	4	0	2	2
Lower Adams River	Oct. 19-30	1,730,609	984,447	1,180,105	1,280,288	23,355	552,022	704,911
Little River	Oct. 19-30	409,480	115,881	105,288	222,393	4,145	95,374	122,874
South Thompson River	Oct. 19-30	123,864	19,152	10,586	5,891	110	2,526	3,255
Lower Shuswap River	Oct. 17-20	9,387	31,205	24,629	29,074	275	14,175	14,624
Middle Shuswap River	Oct. 19-22	499	457	1,872	4,559	0	2,244	2,315
Diverted Sockeye	—	1,006,177	0	0	0	0	0	0
NORTH THOMPSON								
Raft River	Sept. 10-12	10,215	7,613	6,250	4,474	12	2,025	2,437
Barriere River	Aug. 29-31	0	14	4	2	0	1	1
North Thompson River	Sept. 26-28	—	90	46	270	0	122	148
CHILCOTIN								
Chilko River	Sept. 22-24	137,081	92,467	226,702	145,049	9,661	63,483	71,905
Taseko Lake	—	7,538	657	353	Present	—	—	—
QUESNEL								
Horsefly River	Sept. 4-7	1,784	1,001	1,607	1,350	5	453	892
Mitchell River	—	65	5	142	23	0	8	15
Little Horsefly River	—	14	72	4	—	—	—	—
NECHAKO								
Endako River	—	522	236	5	0	0	0	0
Nadina River (Early)	Aug. 19-22	804	450	83	93	0	41	52
(Late)	Sept. 18-22	—	1,683	1,784	4,671	12	2,041	2,618
Nithi River	—	5	25	0	0	0	0	0
Ormonde Creek	—	210	47	5	0	0	0	0
Stellako River	Sept. 29-Oct. 2	112,273	124,495	101,684	45,876	79	16,600	29,197
STUART								
Early Runs								
Ankwil Creek	Aug. 4-6	461	290	86	220	0	99	121
Driftwood River	Aug. 2-4	1,897	374	140	1,983	0	889	1,094
Dust Creek	Aug. 3-5	3,017	1,035	178	963	0	432	531
Felix Creek	Aug. 2-9	515	1,600	979	2,866	0	1,346	1,520
25 Mile Creek	—	218	25	0	0	0	0	0
15 Mile Creek	—	105	25	0	0	0	0	0
5 Mile Creek	Aug. 2-4	111	11	0	108	0	48	60
Forfar Creek	Aug. 4-6	8,715	4,464	1,739	6,476	16	2,942	3,518
Frypan Creek	Aug. 3-5	57	243	58	130	0	58	72
Gluske Creek	Aug. 2-4	1,642	1,841	1,876	5,702	57	2,432	3,213
Kynoch Creek	Aug. 3-5	9,477	8,672	3,591	6,495	27	2,677	3,791
Narrows Creek	Aug. 4-6	1,823	666	322	144	0	65	79
Paula Creek	Aug. 3-5	333	405	0	565	0	262	303
Rossette Creek	Aug. 5-7	3,735	4,887	1,645	7,664	77	3,269	4,318
Sakeniche River	—	500	20	2	0	0	0	0
Sandpoint Creek	Aug. 1-3	875	243	0	358	0	156	202
Shale Creek	Aug. 2-4	657	306	50	34	0	15	19
Misc. Streams	Aug. 2-5	492	339	193	858	0	381	477
Late Runs								
Kazchek Creek	Sept. 16-18	369	77	144	74	0	32	42
Middle River	Sept. 20-24	7,762	11,706	4,917	12,115	22	5,655	6,438
Pinchi Creek	—	850	142	76	0	0	0	0
Tachie River	Sept. 20-23	13,738	6,764	3,600	2,776	55	1,073	1,648
NORTHEAST								
Upper Bowron River	Aug. 27-30	14,871	6,292	2,480	1,341	36	563	742
TOTALS*		3,815,826	1,622,960	1,919,336	1,948,171	82,831	820,350	1,044,990

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

TABLE VII

DAILY CATCH OF SOCKEYE, 1955-1959-1963-1967 FROM UNITED STATES CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1955	1959	1963	1967	1955	1959	1963	1967	1955	1959	1963	1967
1					53,990		112,848	83,010	2,556	23,297		17,852
2					75,245		72,265	94,322		18,812	1,282	
3					45,368	51,046					1,032	
4	7,228					91,067			2,364		47	
5	12,418					89,417	81,546		1,621		10	11,025
6	6,713					139,733	48,585	5,594	1,424			11,025
7	3,409				48,429	167,337	29,274	88,268	703	5,401		6,254
8		CLOSED			81,369	132,596	18,439	58,194	205	10,197		
9				251	54,024					7,266	28	
10				4,465	40,503	93,493				11,143	439	
11	7,824			3,762	25,131	124,278			330		421	2,548
12	8,251					80,698	37,789		255			7,379
13	7,563		CLOSED			74,075	12,228	152,217	37			4,728
14	7,265				30,632		14,300	115,530	131			1,982
15					32,409			104,995	48	747		
16				1,145	31,554			64,753		495		
17				16,742	43,279	125,123				218		
18	16,903			12,781	27,280	83,286			142		32	2,631
19	17,687				2,222	64,087	6,193		70		6	604
20	13,795	7,112					4,269		76			515
21	11,878	5,962			16,714		2,680	189,061	123	154		198
22		5,008	33,394		12,623			197,978	77	99		
23			110,105	5,072	17,133	924		156,371		56		
24			130,412	103,996	10,967	125,615		108,378		8		
25	38,584		94,278	74,382	8,413	67,372			36			11
26	13,949		92,026	67,596		17,846	2,648		6			9
27	29,915	16,216	61,186	54,405		33,994	2,686		27			6
28	30,647	20,278			10,136		2,330		45	1,941		
29		28,340	114,620		5,821		151	41,810	12	645		
30		44,671	121,644	6,455	5,372			27,915		553	19	
31			104,333	146,028	4,307	29,018		31,254				
Totals	234,029	127,587	861,998	497,080	682,921	1,591,005	448,231	1,519,650	10,288	81,032	3,316	66,767
Troll and Outside Seine	10,011	437	240	143	63,702	4,188	203	34	757	27	1	
Monthly Totals	244,040	128,024	862,238	497,223	746,623	1,595,193	488,434	1,519,684	11,045	81,059	3,317	66,767
June, Oct. and Nov. Totals									4,902	6,462	56	4,152
Season Totals									1,006,610	1,810,738	1,314,045	2,087,826

TABLE VIII

DAILY CATCH OF SOCKEYE, 1955-1959-1963-1967 FROM CANADIAN CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1955	1959	1963	1967	1955	1959	1963	1967	1955	1959	1963	1967
1					12,463			19,223	6,361	18,874		
2					53,491			16,577	486	19,749	11,459	
3					44,447	15,439				6,740	8,062	2,170
4	8,734				41,692	16,614	91,288			1,581	10,160	29,490
5	13,388		CLOSED			5,000	70,820		22,777		106	27,699
6	9,539					Strike	54,485	73,831	17,051	3,831		476
7	7,305					July 26	44,820	184,860	14,849	7,269		639
8						Aug. 9	9,987	89,770	12,715	14,422		441
9					64,348	Incl.		114,059	128	27,728	15,879	
10					61,049	228,536				31,362	57	
11	5,701				66,105	145,352				306	12	55,886
12	5,122	CLOSED			38,165	125,006	59,034		146			37,370
13	5,984					127,041	27,942		31,216			793
14	5,960						8,205	183,161	16,921	24,349		318
15					41,061		5,783	129,684	29	22,769		
16			784		52,783			104,460	3	16,543	4	
17			1,503	10,864	31,403	165,960				22,802	2	
18	9,561			8,744	29,679	83,683				18		650
19	7,827			6,984	16,703	41,091	43,585		9			371
20	10,906	10,360					13,553		8			208
21	20,569	8,871					3,146	115,565	1	19,365		
22		12,214	3,757		12,249		3,979	76,188	10	10,636		50,985
23			6,900		27,296	55,943	1,955	36,132	1	19,305	15,557	
24			22,877	47,625	24,536	104,920				15,459		
25	58,985		Strike	21,971	21,638	49,084					6	234
26	45,546		July 12	27,672	7,510	32,174	11,487				0	115
27	26,579	4,672	to	26,691			15,577					108
28	14,064	2,540	Aug. 4				1,175	66,008		6		
29			19,241		4,356		1,276	24,586		2		
30			21,981		20,417		590	5,799		1		
31			47,394	92,491	10,126	31,096		4,370				
Totals	255,770	38,657	124,437	243,042	681,517	1,226,939	468,687	1,244,273	122,711	283,117	61,304	207,953
Troll and Outside Seine	534	2,163	1,673	32,565	39,667	21,458	5,028	125,490		608	3,057	3,470
Spring Salmon Gill Nets		506	732	1,142					693	37	618	
Monthly Totals	256,304	41,326	126,842	276,749	721,184	1,248,397	473,715	1,369,763	123,404	283,762	64,979	211,423
April, June, Oct. and Nov. Totals									7,189	8,398	21,145	17,547
Season Totals									1,108,081	1,581,883	686,681	1,875,482

TABLE IX

SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER RIVER SPAWNING AREAS, 1955, 1959, 1963, 1967

District and Streams	1967 *Period of Peak Spawning*	*Estimated Number of Sockeye* 1955	1959	1963	1967
LOWER FRASER					
Cultus Lake	Nov. 15-20	26,000	48,461	20,571	33,492
Upper Pitt River	Sept. 7-10	17,552	15,740	12,680	10,300
Widgeon Slough	Nov. 1-4	—	637	353	1,006
HARRISON					
Big Silver Creek	—	191	64	9	0
Harrison River	Nov. 16-20	5,595	28,562	22,287	20,577
Weaver Creek	Oct. 14-17	21,330	8,379	14,469	22,617
LILLOOET					
Birkenhead River	Sept. 18-22	25,355	38,604	67,151	58,036
SETON-ANDERSON					
Gates Creek	Sept. 1-7	86	867	4,858	1,665
Portage Creek	Oct. 24-27	43	572	2,011	6,548
SOUTH THOMPSON					
Seymour River	Sept. 1-4	9,511	52,325	71,690	13,361
Upper Adams River	—	0	0	6	—
Lower Adams River	Oct. 15-20	54,405	113,230	151,373	765,161
Little River	Oct. 15-20	9,072	21,080	5,148	74,490
South Thompson River	Oct. 15-18	0	472	45	270
Lower Shuswap River	Oct. 18-21	23	0	23	5,951
NORTH THOMPSON					
Raft River	Aug. 31-Sept. 3	5,364	10,210	8,724	1,303
Barriere River	Aug. 25-28	103	203	92	16
Fennell Creek	Aug. 29-Sept. 1	—	27	439	920
North Thompson River	—	—	—	70	—
CHILCOTIN					
Chilko River	Sept. 24-27	128,081	470,621	1,002,252	176,337
Taseko Lake	Aug. 25-28	4,400	16,410	31,667	5,700
QUESNEL					
Horsefly River	Sept. 1-5	62	Present	86	119
Little Horsefly River	—	—	27	0	—
NECHAKO					
Endako River	Aug. 25-30	594	1,463	2,540	949
Nadina River (Early)	Aug. 24-27	202	351	1,019	1,595
(Late)	Sept. 14-18		1,013	7,304	7,790
Nithi River	Aug. 17-20	79	218	763	1,688
Ormonde Creek	—	27	74	41	0
Stellako River	Sept. 24-28	51,971	79,355	138,805	90,680
STUART					
Early Runs					
Driftwood River	Aug. 8-10	0	3	14	52
Forfar Creek	Aug. 6-9	68	281	652	4,815
Gluske Creek	Aug. 4-8	99	97	0	1,368
Kynoch Creek	Aug. 4-8	1,029	1,123	2,147	6,694
Narrows Creek	Aug. 8-11	27	167	180	454
Rossette Creek	Aug. 6-8	916	911	1,600	6,566
Misc. Streams	Aug. 8-16	31	81	34	1,120
Late Runs					
Kazchek Creek	Sept. 10-12	18	7	364	92
Middle River	Sept. 19-23	3,596	3,500	1,838	972
Tachie River	Sept. 20-22	4,000	2,500	1,035	576
NORTHEAST					
Upper Bowron River	Aug. 28-Sept. 1	9,355	29,247	25,144	31,695
TOTALS*		379,185	946,882	1,599,484	1,355,295

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

TABLE X

DAILY CATCH OF PINKS, 1963-1965-1967-1969 FROM UNITED STATES CONVENTION WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1963	1965	1967	1969	1963	1965	1967	1969	1963	1965	1967	1969
1	CLOSED			13	52,307		7,164				145,934	
2				36	48,241	2,533	8,084		386,713			124,314
3						1,312		2,689	215,316			161,294
4						6,736		1,941	75,268			
5		84			68,013	15,117		2,099	61,129		362,417	
6		124			52,218		199				261,626	
7				23	40,441		6,635			108,690	144,223	
8				25	30,906		10,666			68,470		2,418
9			2	33		14,502			103,803	27,983		8,677
10			29			11,818			193,448			127,783
11			39			11,865		3,627	188,781		157,616	57,856
12		674			102,743			1,783			149,560	
13		483			98,389		24,236	2,521		13,716	124,201	
14				443	84,776		41,126	2,081		4,316	89,874	
15				362			45,622			109		42,946
16			10			29,700	53,414			46		19,249
17			322			26,038						1,072
18			209					17,014	91,403		96,316	
19		1,729			173,834			22,877	24,221		48,221	
20		2,504			166,400					6,185	39,802	
21		2,272		967	181,808		133,050			2,036	17,651	
22	7,831			547			191,662			2,099		16,381
23	19,156		275	665			140,804		26	2,402		19,181
24	17,490		6,873				172,829		41			11,860
25	35,819		6,010			60,960		98,003	23		943	5,347
26	27,844		5,622		427,506	46,508		119,947	14		769	
27	22,440		5,952		349,273					940	323	
28		3,799		2,080	263,222					530		
29	37,626	3,469		2,565	164,078		483,011			335		4,461
30	44,316		3,897	1,259			366,854		12,753	180		2,265
31	44,595		10,619				262,997					
Totals	257,117	15,138	39,859	9,018	2,304,155	227,089	1,948,353	274,582	1,352,939	238,037	1,639,476	605,104
Troll	133,114	21,986	48,377	5,524	327,235	53,630	132,751	32,702	20,550	1,832	9,297	1,267
Monthly Totals	390,231	37,124	88,236	14,542	2,631,390	280,719	2,081,104	307,284	1,373,489	239,869	1,648,773	606,371
June, Oct. and Nov. Totals									31,122	668	8,927	17,600
Season Totals									4,426,232	558,380	3,827,040	945,797

TABLE XI

DAILY CATCH OF PINKS, 1963-1965-1967-1969 FROM CANADIAN CONVENTION WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1963	1965	1967	1969	1963	1965	1967	1969	1963	1965	1967	1969
1				24			528					40,906
2				15		10,495	474		67,539			35,463
3						12,117			182,611		117,540	
4					5,237	10,252		5,777	210,058		134,138	
5					31,344			4,773	178,872		128,994	
6		3			57,540		10,829	5,684			65,626	
7		2			67,174		14,045			17,544	93,898	91,986
8					775		17,863			10,086	100,559	29,915
9						23,992	20,326		24,161	5,416		25,639
10						24,346			131,138			17,039
11						25,866		6,345	91,215		218,008	108,797
12	Strike	10			77,691			3,674			136,118	
13	July 12	10			86,575			4,641		6,151	73,745	
14	to			34	81,750		146,394			4,110	31,250	
15	Aug. 4				106,538		108,014			3,383		
16						49,953	105,629		14,390	3,314		
17			8			43,342			8,865			11,653
18			7			40,776		25,980			29,284	10,891
19		22	4		142,007			12,711			16,313	
20		49			113,020			414		52,695	10,361	
21		182		74	125,864		67,700			718		
22				85	372,486		150,862			383	54,442	
23					187,652		168,186		71,976			2,206
24			328									2,196
25			266			81,419			5,651		10,133	
26			308		12,340	37,969		1,074	1,790		6,294	
27		353	454	273	419,589					317	4,998	
28		147		1,848	243,875		210,531			163		
29		198		2,315	229,443		293,634			32,671		
30		70		2,044	220,827	5,307	239,917	36,049				477
31			1,037	1,324			221,137	49,946				
Totals	0	1,046	2,412	8,036	2,581,727	365,834	1,776,069	157,068	988,266	136,951	1,231,701	377,168
Troll	100,316	14,990	99,288	35,622	214,245	51,148	663,415	150,136	106,578	7,378	197,605	26,298
Spring Salmon Gill Nets									12,894	13,508		55,538
Monthly Totals	100,316	16,036	101,700	43,658	2,795,972	416,982	2,439,484	307,204	1,107,738	157,837	1,429,306	459,004
June, Oct. and Nov. Totals									169,262	1,612	186,432	51,639
Season Totals									4,173,288	592,467	4,156,922	861,505

TABLE XII

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

District and Streams	1969 *Period of Peak Spawning*	*Estimated Number of Pink Salmon*			
		1963	1965	1967	1969
EARLY RUNS					
LOWER FRASER					
Main Fraser	Oct. 8-15	516,831	543,757	785,797	848,532
HARRISON					
Chehalis River	Oct. 10-14	12,394	7,621	5,625	7,147
FRASER CANYON					
Coquihalla River	Oct. 10-16	14,971	3,845	3,045	2,415
Jones Creek	Oct. 10-16	3,500	3,000	3,162	1,779
Misc. Tributaries	Oct. 10-16	4,081	1,057	2,395	450
SETON - ANDERSON					
Seton Creek	Oct. 10-17	121,424	95,046	225,351	198,854
Portage Creek	Oct. 10-17	8,013	5,931	7,822	1,092
Bridge River	Oct. 12-18	6,422	23,657	6,547	13,034
THOMPSON					
Thompson River and Tributaries	Oct. 10-18	285,243	233,100	450,487	247,896
TOTALS*		972,879	917,736	1,490,231	1,321,199
LATE RUNS					
LOWER FRASER					
Stave River	——	910	226	276	——
HARRISON					
Harrison River	Oct. 16-20	645,476	69,213	64,576	96,390
Weaver Creek	Oct. 16-20	693	528	786	725
CHILLIWACK-VEDDER					
Chilliwack-Vedder River	Oct. 21-25	317,750	193,911	252,585	92,222
Sweltzer Creek	Oct. 18-29	15,215	8,908	19,586	18,923
TOTALS*		980,453	273,387	341,141	208,260
GRAND TOTALS		1,953,332	1,191,123	1,831,372	1,529,459

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

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